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FEBRUARY 1955
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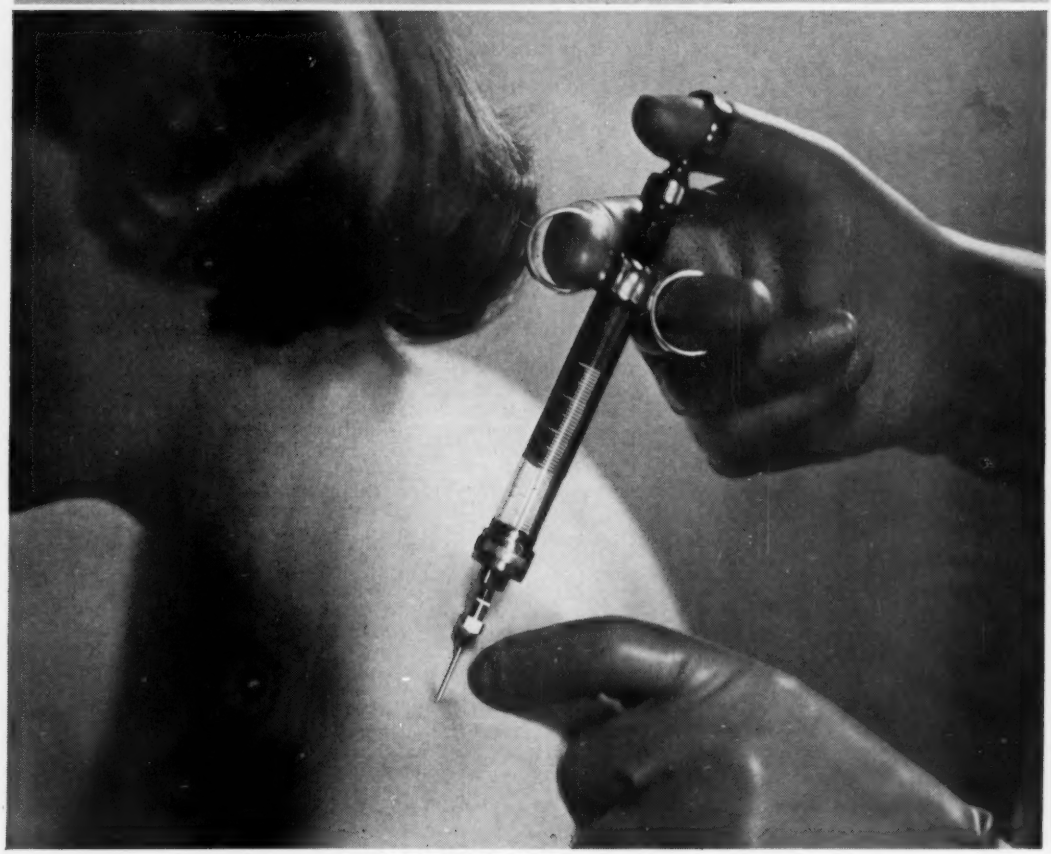

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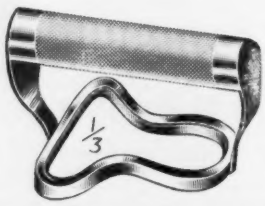

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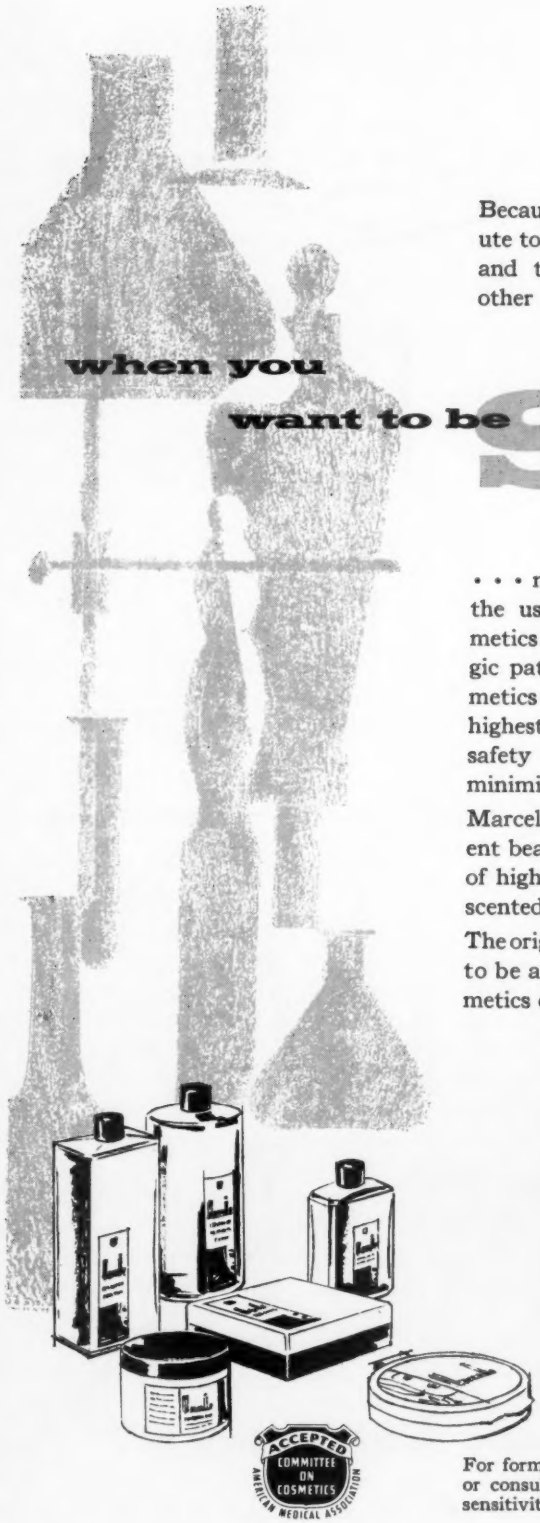

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MALIGNANT LESIONS OF THE NASOPHARYNX

SIDNEY H. DUBOE, M.D., Los Angeles

WE MUST give careful attention to the nasopharynx if we are to diagnose the lesions in this area soon enough to render therapy of any value. Here, early diagnosis is made less frequently than in other lesions of the respiratory tract. This is due to several factors:

1. Failure of this lesion to produce early local symptoms to make both patient and physician cognizant of its possible presence.

2. Failure of the physician to make careful inspection of the nasopharynx because of misinterpretation of the patient's symptoms. Graham and Meyer, in the journal *Radiology*, state, in reporting 25 cases of malignant lesions of the nasopharynx, "more than one-half of the patients were under the care of a physician and had one or more nasal operations without primary lesion being recognized."

3. Adequate examination of the nasopharynx is very often a difficult procedure, especially in patients who are gaggers and who have narrow nasopharyngeal vaults; the examining physician is pressed for time and very often passes up such an examination. In my opinion, every patient's nasopharynx can be examined with a mirror if time is taken to instruct the patient how to cooperate. It may be necessary to anesthetize the pharynx with tetracaine (Pontocaine) hydrochloride. The nasopharyngoscope and Yankaur speculum are important instruments for direct visualization. I prefer to use the nasopharyngeal mirror wherever possible.

From the Department of Otolaryngology of the College of Medical Evangelists.

Read at a meeting of the Section of Otolaryngology of the Los Angeles Society of Ophthalmology and Otolaryngology, March 23, 1953.

It should be the routine responsibility of the otolaryngologist to examine each new patient's nasopharynx, especially in those patients with suspicious symptoms. This responsibility does not end until a biopsy specimen deep enough in the lesion is taken. It is possible to miss the tumor tissue if the biopsy specimen is not taken deep enough. One should not temporize until cervical metastasis or invasion of the skull occurs.

In most cases the lesion may be seen either as a mass or as an ulcer or as asymmetry of the nasopharynx. In few, the primary lesion may be small and easily overlooked. Many patients are seen in the late stages of cancer of the nasopharynx because of negligence on the part of the first examiner either to discover the lesion or to take an adequate biopsy specimen.

Unfortunately, the nasopharynx is a silent area, and the patient consults an otolaryngologist when the lesion has already metastasized or invaded other vital structures.

Simmons and Ariel, reporting 150 cases in *Surgery, Gynecology and Obstetrics with International Abstract of Surgery*, found a lump in the neck in 83.3% of the patients with nasopharyngeal malignancies, and cranial nerve involvement in 29.3% of the patients, with the sixth nerve most commonly involved. There was pain in the side of the face and neck in 16.6% of the cases. Ear symptoms, such as deafness, tinnitus, and a sense of fullness, were less frequent (7.3%).

A review of the literature by New and Erich reveals that malignant tumors of the nasopharynx are three times as frequent as benign tumors of this area. They are about 2% of all the malignant growths of the head and neck. These lesions occur in 1 out of about 13,000 patients examined. Godtfredsen collected 454 cases of malignant diseases of the nasopharynx from four Scandinavian

clinics and reported that these lesions constitute 0.4% of all malignant lesions.

The usual site for these lesions is in the order of the following frequency:

1. Fossa of Rosenmüller
2. Posterior wall, to one side of the midline
3. Roof, to one side of the midline

In regard to origin, the carcinoma is believed to arise from the low columnar ciliated epithelium of the nasopharynx, and it invades the subjacent tissues in closely packed columns or plaques. The sarcomas arise from the lymphatic tissue.

The Chinese have a higher incidence of this disease. In Hong Kong, it is the second commonest malignant disease. The disease occurs in various age groups, especially in persons between the ages of 40 and 60 years. Martin and Brady treated a 4-year-old child. Whiteleather treated a 10-year-old child. Males are said to be the more predominant sufferers.

The prognosis is unfavorable, at the best, even when the lesion is discovered early. The sarcoma group offers a more favorable outlook than the carcinoma. Malignant lymphoma, reticulum-cell sarcoma, lymphoepithelioma, and the transitional-cell carcinoma respond well to irradiation but leave a high rate of recurrence. Cranial nerve involvement is an unfavorable sign. Actual decalcification of the bone at the base of the skull is an almost certain fatal sign; however, irradiation contributes a considerable amount of palliation and may prolong life. The disappearance of the primary lesion and its metastasis is little cause for optimism, because the recurrence rate is very high: 50% of the cases will develop recurrence, with 37% in the first year. Various reports indicate that 20% of the patients surviving are free of symptoms. Godtfredsen, in reviewing a nine-year survival rate, found a 5% survival rate for patients with carcinoma and a 20% rate for those with sarcoma.

Metastases are usually limited to the cervical nodes, with pulmonary involvement next in frequency. It is important then to x-ray not only the skull but also the chest. X-ray of the skull in axial and lateral views is most important. Direct extension through the foramen lacerum, foramen ovale, and the jugular and orbital fissures to the base of the skull will be evident on x-ray by enlargement of the openings.

Treatment of these lesions is relegated to the radiologist. The otolaryngologist must cooperate with the radiotherapist to indicate the position and size of the primary lesion. The otolaryngologist must assist the radiologist by watching the amount of secretion, for this is the reaction the radiologist is guided by in concentrating the dosages. The degree of cooperation between the otolaryngologist and the therapist is an important factor in the success or failure of the therapy.

REPORT OF CASES

CASE 1.—M. W., a 29-year-old soldier, who had had about two weeks' military service, was admitted to Ward 4 because of a tumor in the left side of his neck. The patient stated that about two months before he entered the service his barber called attention to a swelling in the left side of his neck. That was the first time he had become conscious of this, and it gave him no pain and grew no larger. He did not know of any cause for it; he denied trauma and gave no history of sore throat, mouth disease, or infections of any kind. On physical examination there was a small freely movable nodular tumor on the left side of the neck, which seemed to be attached to the deep surface of the sternomastoid in its upper third. No other nodules were felt except possibly some small lymph nodes just below that. The rest of the physical examination was essentially negative. The tumor had been there about two or two and one-half months. He had a very thorough examination by the nose and throat department.

Examination by the E. N. T. clinic was negative except for slight hyperplasia of the lymphoid tissue in the nasopharynx.

The blood picture was normal. WBC was 6,500, with 57% neutrophiles and 49% lymphocytes. The chest film was negative.

An excision biopsy of the cervical lymph node was done. A diagnosis of carcinoma, "lymphoepithelioma" type, was made. Since the hypertrophy of the adenoids was out of proportion to the size of the tonsils, which were small, a biopsy of the adenoid tissue was done, but tumor was not found. The second procedure consisted of a complete adenoidectomy.

Microscopic examination: The tissue had the general architecture and appearance of adenoid

tissue. The surface was covered with normal respiratory-type epithelium, which was intact over blocks taken. Several cross sections of crypts lined by the same type of epithelium were noted. Two of the fragments were diffusely infiltrated by irregular poorly delineated pale masses of moderately large cells with pale ovoid or lobulated nuclei with prominent nucleoli. The cells had a relatively small amount of poorly delineated cytoplasm. The tissue cells tended to overlap, and intermixed with them were scattered lymphocytes and a few neutrophiles. Except for replacement of the lymphoid tissue, the tumor caused little reaction in the surrounding tissue or disturbance of the architecture. In one area, the tumor cells formed what appeared to be an atypical crypt, suggesting that the area might have been the place of origin from the epithelium of the crypt.

This was the primary site of the metastatic tumor found in the cervical lymph node. Its appearance, as described here, fits the description of "lymphoepithelium" even more closely than did the metastatic tumor.

Progress: The patient was seen at the Veterans Administration Hospital, Hines, Ill., in 1946, at which time he was symptom-free. A letter dated Feb. 8, 1954, received from the patient, stated that he was doing well and had had no recurrence. On March 26, 1946, at the Veterans Hospital, a biopsy specimen taken from the right Rosenmüller fossa revealed chronic inflammation.

Case 2.—M. D. was seen in consultation on July 17, 1951, at one of the local hospitals because of postnasal hemorrhage. She stated that she had been treated previously at a local E. N. T. clinic on June 23, 1951. A letter from the clinic stated that she complained of nasal obstruction on the left side of three months' duration and spitting up of bloody mucus of two weeks' duration. It was noted that she had a granulomatous mass on the left posterior wall. Some thickening and slight tenderness were along the middle of the left sternocleidomastoid muscle, but there was no distinctly palpable mass. Blood Wassermann was negative. Biopsy report stated granulomatous pharyngitis.

The nasopharyngeal examination revealed a mushroom-like mass with an ulcerated surface, red and spongy looking, with a crater in the center. Otherwise the E. N. T. examination was negative.

This mass was removed with Yankaur speculum and punch forceps. Microscopic sections of this lesion proved it to be reticulum-cell sarcoma. The patient was further treated by radiation. Visualization of the nasopharynx on Sept. 5, 1951, showed the nasopharynx to be free of pathology.

Report of the microscopic examination: On the surface of one or two pieces there was found a transitional type of epithelium. The greater part of the tissue consisted of tumor. The tumor cells were

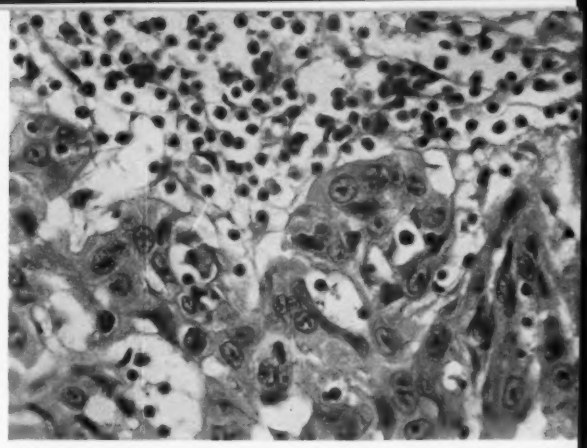


Fig. 1 (Case 1).—Carcinoma, lymphoepithelioma type.

large with relatively large vesicular nuclei containing one or more small nucleoli. Cytoplasm was not abundant but, when seen, tended to be rather pale-staining. Mitoses were frequently seen. These cells formed large masses, or, more frequently, they were separated into groups of varying size by slender connective-tissue strands. There was a considerable amount of inflammatory reaction in some areas, and some necrosis was present.

Diagnosis: reticulum-cell sarcoma.

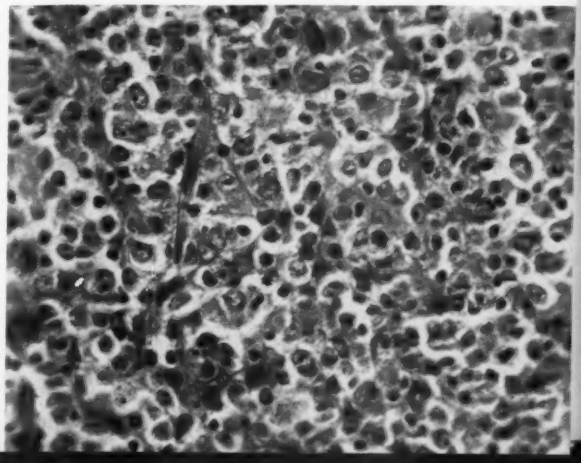
On Nov. 22, 1953, the patient was hospitalized for the removal of a mass in the right axilla. At the time of surgery there was extensive involvement of the right axillary nodes, which proved to be Hodgkin's disease, microscopically.

Bone-marrow studies indicated no pathological diagnosis, normal marrow.

White blood cell count was 8,300, with polymorphonuclear leucocytes, 66; lymphocytes, 29; mononuclear cells, 5.

Microscopic examination: Effacement of the normal architectural pattern of the lymph node was brought about by the polycellular infiltrate. There was extensive reticulum-cell proliferation and histiocytes, with extensive areas of necrosis and, in other places, the formation of sarcoid-like tubercles. The areas of necrosis were surrounded by granulation tissue, which was infiltrated with leucocytes. The fat around the nodes showed fibrosis. Eosinophiles were noted particularly in the areas of reticulum-cell proliferation and the areas of granuloma forma-

Fig. 2 (Case 2).—Reticulum-cell sarcoma.



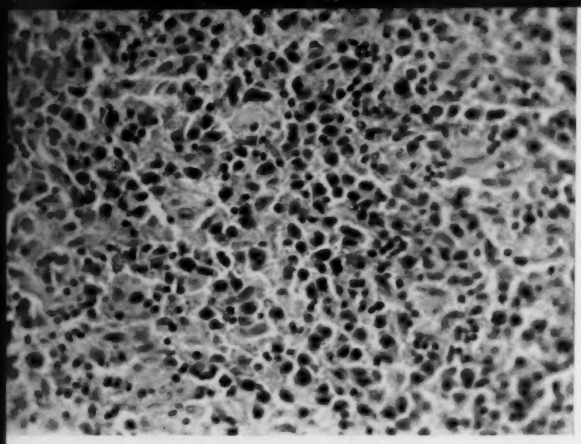


Fig. 3 (Case 2).—Hodgkin's disease.

tion. No acid-fast organisms were seen in specially stained smears.

Diagnosis: Hodgkin's disease, lymph node, right axilla.

Case 3.—A. C. was seen at my office on Feb. 3, 1953, and the history given was that in November, 1952, she had developed a fullness and impaired hearing in her right ear, for which she had seen an E. E. N. T. physician. She stated that she was told that an ulcer was seen in the nasopharynx, which caused swelling of the Eustachian tube. Not improving after six weeks of treatment, she consulted another physician. According to the patient, no biopsy specimen was taken.

Examination revealed the nasopharynx to be ulcerated on the postpharyngeal wall, extending from the right Rosenmüller fossa, where a small ulcerated mass could be visualized. This ulceration extended almost to the opposite Eustachian tube. The lesion was covered with a dark, dirty-gray crust that was resistant to removal. The torus tubarium was edematous. The pharynx, oropharynx, hypopharynx, and larynx were normal. Ears: Canals were normal. The right drum was somewhat retracted anteriorly. No fluid level could be visualized. Otherwise, the landmarks were visible. The left drum was normal. Catheter inflation of the right Eustachian tube revealed it to be patent.

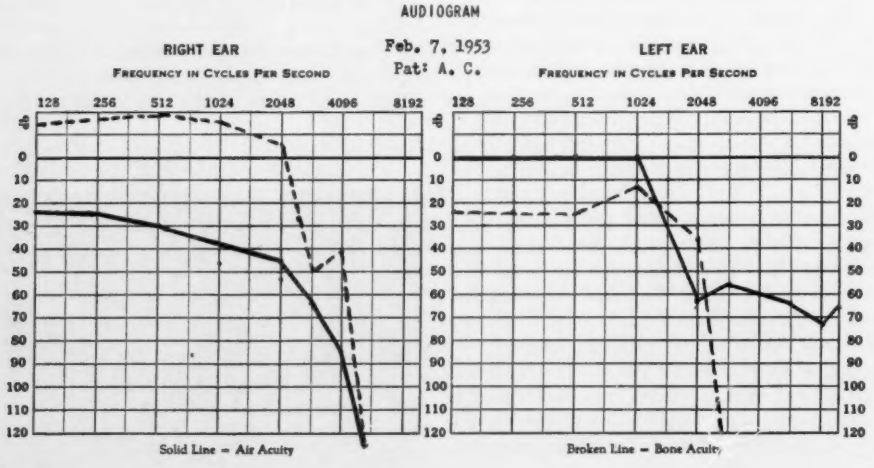
A biopsy specimen of this lesion was taken on Feb. 5, 1953, and revealed squamous-cell carcinoma. The Wassermann reaction was negative. X-rays showed no invasion of the skull.

Progress: Patient responded poorly to treatment and went downhill. Right eardrum ruptured and drained. Masses of tissue presented themselves into the middle ear, from which a biopsy specimen was taken and revealed squamous-cell carcinoma. She developed trismus and was able to open her mouth only partially. The lesion extended into the middle cranial fossa and eroded the petrous apex. This was associated with a transitory abducens paralysis, with a manifest external rectus paralysis causing diplopia for about two weeks. The diplopia cleared up completely. The lesion extended anteriorly and invaded the soft palate. The entire torus tubarium was destroyed. The lesion invaded the middle ear by direct extension through the Eustachian tube, also extended across the posterior pharyngeal wall, and invaded the left Rosenmüller fossa, torus tubarium, and Eustachian ostium. The middle ear developed a serous otitis media. The right orbit was finally invaded; the eye became proptosed, fixed, and congested, probably due to either direct extension into the orbit or cavernous sinus thrombosis. She died on Dec. 2, 1953.

Audiogram of Feb. 7, 1953, revealed the hearing loss, as calculated on the Maico hearing-loss calculator, indicated AD 45%, AS 42% for air conduction and 6% AD and 31% AS for bone conduction.

Microscopic examination of Feb. 5, 1953: Sections showed pieces of mucous membrane of stratified squamous epithelium. It was irregularly thickened,

Fig. 4 (Case 3).—Audiogram of the right and the left ear.


AUDIOGRAM
RIGHT EAR
Feb. 7, 1953
Pat: A. C.
LEFT EAR
Frequency in Cycles Per Second
128 256 512 1024 2048 4096 8192
-5 0 10 20 30 40 50 60 70 80 90 100 110 120
Solid Line = Air Acuity
Broken Line = Bone Acuity

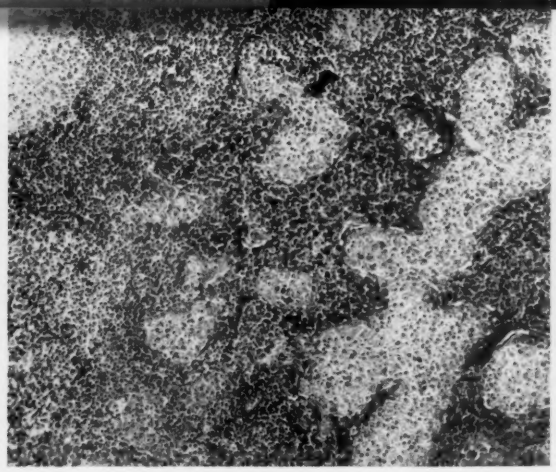
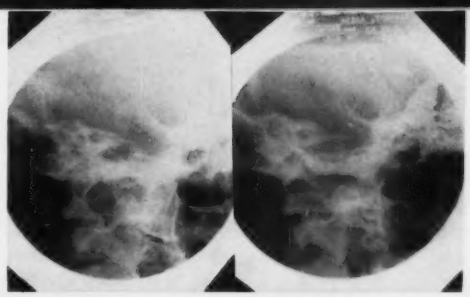


Fig. 5 (Case 3).—Squamous-cell carcinoma.

Figure 6 (Case 3).



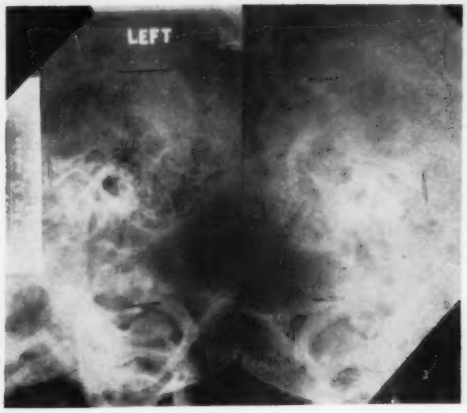


Figure 7 (Case 3).

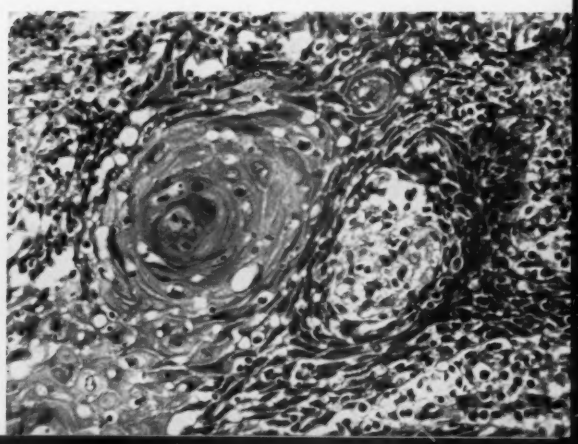
and there were a few penetrating or infiltrating strands extending down into the subjacent mucous glandular tissue. The epithelial cells for the most part were well differentiated, contained keratohyaline. In some of the penetrating pegs there were a few small well-formed epithelial pearls. The submucous tissue was heavily infiltrated with lymphocytes and plasma cells.

Histologically this appeared to be squamous-cell carcinoma of a relatively low-degree malignancy.

Diagnosis: squamous-cell carcinoma.

X-ray films, basal view, of March 17, 1953, showed no definite areas of bone destruction, although there was some haziness over the medial portion of the right petrous pyramid. A repeat basal view on May 27th showed loss of bone detail in the medial portion of the right petrous pyramid, but the bone destruction could not be identified for certain. The foramen ovale and foramen spinosum were normal in appearance. X-rays of the mastoids with the patient in the Law position showed a cloudiness in the right mastoid, with a breakdown

Fig. 8 (Case 4).—Squamous-cell carcinoma.



of cell detail and loss of aeration, as compared with the opposite side. A frontal view showed the petrous pyramids satisfactorily, without any evidence of bone destruction or other disease involvement. On June 2nd, a repeat basal study showed marked haziness and loss of bone detail in the medial portion of the right petrous pyramid, with the foramina spinosum and ovale apparently still intact. Films with the patient in the Stenver position showed definite decalcification of the medial portion of the petrous ridge, as compared with the intact left petrous ridge. On June 30th, films of the base of the skull indicated that the medial portion of the petrous ridge was considerably wiped out, evidently the result of destruction, but there was so much edema that it was not possible to determine with certainty how much bone involvement was present in these films.

Treatment consisted of cleansing the nose and ear of foul-smelling purulent discharge, combined with antibiotic and irradiation therapy.

A radium pack consisting of two 25-mg. tubes in a rubber colpostat was held in place in the posterior pharynx for 30 minutes on Feb. 12, 1953, for a dose of 1,500 mg.-hr. The tumor dose is estimated at 3,500 mg.-hr. X-ray therapy was administered through four portals, namely, both antral areas and the left and right nasopharyngeal regions. Treatment was given at the rate of two portals per day, 150 r per portal, and therapy was given daily, five days a week. Treatment was carried on consecutively from Feb. 17th until April 3rd. The air dose to each of the portals was approximately 2,300 r. The tumor dose is estimated to be about 5,000 r.

CASE 4.—L. M. was seen by a colleague in general practice on May 7, 1952. The patient had severe occipital headaches extending to the frontal and parietal regions of three weeks' duration. Acetylsalicylic acid, caffeine, and acetophenetidin (Empirin) compound with codeine gave her relief. She also complained of ringing in the left ear. She had been treated for several weeks by an otolaryngologist for pharyngitis.

The examination done by this colleague revealed a nodule in the left side of her neck in the infra-auricular region, which was tender. Also, she had a nodule on the right side. X-rays of the skull and sinuses were negative.

One of the nodules was removed from the neck, and the pathological report was squamous-cell carcinoma, probably metastatic.

The patient was referred back to the otolaryngologist, who took a biopsy of the primary lesion in the nasopharynx. The patient died of cachexia in November, 1952.

Microscopic examination: Sections showed infiltrating masses of squamous-cell carcinoma extending into fibrofatty tissue containing several large deposits of lymphoid cells. The tumor cells were usually large, irregular, and polyhedral, and some contained keratohyalin. There was also a mild abortive effort to form epithelial pearls. The nuclei were large, usually pale and vesicular, but in some of the masses they were smaller and more hyperchromatic. Mitoses were relatively infrequent.

This tumor was possibly metastatic in the lymph node, but the remote possibility of its originating in a branchial cyst should be considered.

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MALIGNANT DISEASES OF NOSE AND SINUSES

CLAUDE D. WINBORN, M.D., Dallas, Texas

HISTORY

IN NO FIELD of medicine has there been such intensive and constant investigation as in the field of malignant diseases. In the present decade, during which dramatic and far-reaching medical discoveries have been made, cancer still occupies a prominent position in the studies of research laboratories as well as in the fears of the laity. Financial and technical advantages of the researcher have reached a high level, but very little knowledge has been gained that may be applied to the prevention of the disease.

That the medical men of ancient times were cognizant of malignant diseases of the nose is attested by the earliest writings of the learned great. Although Hippocrates held the view of nonsurgical treatment of these lesions, Galen and his followers were perhaps the first to remove them by knife, hot irons, and caustics. They recognized that incomplete surgical treatment caused the tumor to increase in its rate of growth.

At that early period the theory of the origin of malignant nasal conditions was based on the humoral theory: the body being flooded by bile in an unhealthy state. It then became necessary to rid the body of the diseased bile and prevent its recurrence. Medical teachings apparently held to this theory until the important discoveries of the 17th century in gross and microscopic anatomy caused serious doubting of the theory that had been accepted for so many centuries. The lymphatic system having been discovered, the lymph was suspected of being in some way responsible for tumor formation.

It was not until the 19th century that the contributions of such researchers as Laennec and Virchow in microscopic pathology cast into definite oblivion both the humoral and the lymph theories of the origin and growth of tumors. It was then possible to begin study of the differentiation of tissue growth and an enlightened classification of tumors.

In the earlier reports dealing with tumors of the nose and sinuses the description of the tumor was so vague that one wonders whether the writer was dealing with a malignant tumor, a benign tumor, or one of the granulomas. During the latter half of the 19th century the first reports of significant statistical value began to appear in publications. In the first of these the tumors were roughly classified as epitheliomas and sarcomas, the sarcomas invariably being the greater in number. Present-day statistics, which show 15% to 20% of these tumors to be sarcomas, cast doubt on the histological diagnosis in those early reports. Very likely, if those tissues could be reexamined today, many of the sarcoma group would be considered to be of epithelial origin or benign tumors. Darnall [1] cites Bosworth, who in 1889 compiled from statistics 41 cases of sarcoma and 30 cases of carcinoma. He then cites Gibb [2] as adding 70 cases of sarcoma and 48 of carcinoma—making a total of 111 cases of sarcoma and 78 of carcinoma. Eggston [3] found that the Manhattan Eye and Ear Hospital had 53 cases of carcinoma and 24 of sarcoma of the nose and sinuses between 1930 and 1940. Of 71 cases of all types in Capps' [4] series, in 1950, only 4 were of sarcomatous type. Windeyer * found 12 sarcomas among 141 cases. New and Cabot [7] cite 91 primary tumors of the antrum; 63 were squamous cell tumors, and 20 were sarcoma. Of 50 secondary

From the Department of Otolaryngology, Southwestern Medical College of the University of Texas.

Presented as a candidate's thesis in partial fulfillment of the requirements for membership in the American Laryngological, Rhinological and Otological Society, Inc.

* References 5 and 6.

tumors of the antrum, 30 were squamous cell and 4 sarcoma. In 1899, Jonathan Wright [8] found it difficult to differentiate between syphilitic lesions and small round cell sarcomas. He found that many mistakes were made and advocated potassium iodide on a trial basis. A more thorough knowledge of histopathology, correlated with clinical behavior of tumors, has resulted in uniformity of classification of material to the numerical advantage of tumors of epithelial origin.

One notices in reviewing the literature that a fair amount continues to be written about this subject. The majority of these publications, however, deal with only a few cases, for the purpose of presenting purely therapeutic measures, clinical features, or histological classification. Only occasionally does one find an author who has dealt with a sufficient number of cases over an adequately long interval to derive statistics of value in determining the rationale of any type of therapy.

While earlier reports of this century advocated purely surgical means or purely roentgenological means of removal of tumors, it was recognized soon that combined surgery and irradiation might improve results. An advocate of roentgenological means of treatment, Quick [9] reported 136 cases in 1930 in which surgery was used to obtain drainage and intracavitary irradiation. Barnes,[10] Green,[11] and New,[12] of American authors, and Woodman,[13] Harmer, † and Patterson,[17] representing the English, were among the first to use combined methods of treatment.

The next significant advance in treatment was developed in America early in the 20th century. Recognizing that resection and open surgery were not resulting in enough cures, New, in 1918, revived the use of actual cautery and later substituted diathermy. Clark,[18] as early as 1907, used fulguration and was perhaps the first in America to use diathermy coagulation in a large number of cases.

In 1935, New and Cabot [7] reported 141 cases of malignant diseases of the antrum treated by electrosurgery and irradiation, with 44.9% five-year cure rate. Windeyer ‡ considered his improved results to be the result of combined radiotherapy and coagulation. Ohngren, a sincere advocate of electrosurgery, reported that 38.5% of 52 patients treated in 1932 were free of disease for five years. These reports and many others seem to bear out the contention that the use of electrosurgery, and particularly coagulation, lends a distinct advantage over scalpel surgery.

OBJECT OF THE STUDY

It is not the object of this study to present a group of successfully treated cases which the author may view with pride. On the contrary, it is with the intention of being self-critical in trying to analyze the causes of failures that this undertaking was considered. Since the percentage of favorable results is much higher in the earlier and less advanced cases, a review of the earlier symptoms will be made along with diagnostic signs and methods, with the hope that more cases may be recognized early. Finally, methods of treatment with emphasis on causes of failures will be discussed. Very little of this material is original, with the possible exception of its application in specific instances. Practically all the material on symptoms and diagnosis has been confirmed by personal observation.

It was thought necessary to review some of the characteristics and clinical behavior of the primary malignant tumors of the nose and sinuses. This material, mostly confirmed by clinical observation, was obtained during conferences with pathologists as well as from textbooks and the literature. It is imperative that one have an understanding of these tumor characteristics if proper management is to be carried out.

PATHOLOGY

The histological classification of malignant tumors about the head and neck is not complete unless consideration is given to certain of the tumors which are considered benign in areas where their complete removal is

† References 14-16.

‡ References 5 and 6.

possible. Included in this group are the fibroma, chrondroma, neuroma, and the angioma, which are destructive by expansion or infiltration and which, when incompletely removed, have marked tendencies to recurrence; though they rarely metastasize, they should be considered malignant because of their location. There are many recorded deaths resulting from the activity of these tumors.

The majority of malignant tumors of the nose and sinuses are of the epidermoid type. There are several possible causes for the location of squamous cells in an area normally occupied by columnar epithelium: chronic infection and irritation of respiratory epithelium with metaplasia; invasion of the antrum from a tooth socket; embryonic squamous cell rests, or the lining of a dermoid cyst.

It is generally agreed that some classification of a tumor which estimates its degree of malignancy is desirable, and several such classifications have been proposed. Originally, Broder's classification was accepted by most Americans, and it continues to be used in some quarters to the present time. Any such classification is useful if it is remembered that it only describes the cell structure of that part of the tumor from which the biopsy was taken, in so far as maturity is concerned, and that different parts of the same tumor may vary extremely in degrees of maturity. The prognosis of any tumor, including certain of the benign growths, depends upon extent of invasion, which governs operability, and its radiosensitivity as much as on its microscopic classification.

Most epidermoid carcinomas of this region are of medium differentiation, although the highly malignant transitional cell carcinoma is occasionally found. Eggston and Wolff [3] state that squamous cell carcinoma is usually of high malignancy, but of 98 cases of Ohngren's series,§ 58 were said to have hornification. Of 75 cases of carcinoma of all sinuses, Windeyer ‖ reported that 22 cases were keratinizing squamous cell type, 23 contained little keratin, 18 were transitional cell type, 9 were undifferentiated spheroid carcinoma, and 3 were adenocarcinoma.

The adenocarcinomas arise from the seromucinous glands of the upper respiratory tract. They are tumors that contain glands or have a tendency toward gland formation, and they occur as two principal types. Depending upon the fibrous tissue content and the vascularity, they may be soft or hard and scirrhous. Usually there is a poor capsule, which causes difficulty of dissection and delineation, and there is a marked tendency to invade adjacent structures rapidly. Adenocarcinomas are not commonly found in the nasal cavity and sinuses. Only 6 of New's 91 primary lesions of the antrum were adenocarcinoma. Ringertz [21] reported only 10 cases treated at Sabbatsberg and Radiumhemmet between 1921 and 1936. Adenocarcinomas of the nasal cavities have very bad prognosis, although they seldom metastasize. Their inexorable invasiveness makes complete surgical removal difficult, and failures are marked by continued local invasion.

The frequency with which the malignant connective tissue tumors occur cannot be accurately arrived at, since in many published cases they are only called sarcomas. Eggston and Wolff [3] believe that fibrosarcoma occurs more often than any other sarcoma, but Ringertz [21] reviews the literature and shows that round cell sarcoma occurred 33 times compared with 23 fibrosarcomas. In New's series there were 11 fibrosarcomas to 8 round cell sarcomas. If there were uniformity in classification by all pathologists, these figures undoubtedly would show change.

The sarcomas may arise from practically any location in the nose or sinuses, since they apparently originate in the periosteum or lymph structures. Excepting osteogenic sarcoma, they generally are soft polypoid or smooth nodular masses, reddish or grayish red. The spindle cell sarcoma tends to ulcerate, a characteristic not generally found in the others.

The myxosarcoma is usually very slow growing, tends to occur in young people, and

§ References 19 and 20.

‖ References 5 and 6.

carries a good prognosis. It does not metastasize. The other sarcomas grow by infiltration and expansion; growth may be very rapid, with distant and, excepting in osteogenic sarcoma, regional metastasis. The round cell sarcoma is radiosensitive to the extent that surgical removal is contraindicated, but the fibrosarcoma, spindle cell sarcoma, and osteogenic sarcoma are only slightly radiosensitive. Their treatment is combined radiotherapy and surgery. The prognosis is bad.

Plasmacytoma is so rare a tumor of the upper air passages that mention of it is made only because of two cases in my series. Destructive plasma cell tumors are definitely malignant and are thus differentiated from inflammatory infiltration.[27] There is a tendency for these tumors to metastasize to skeletal bones, and the resulting cell closely resembles that of multiple myeloma. The plasmacytoma may be single or multiple and may metastasize early or late. However, myeloma is considered in some quarters to be a primary tumor of the same etiology as plasmacytoma. In one of my cases the metastatic lesions were discovered first and were the cause of death. The primary lesion in both antrums, removed by surgery and irradiation, showed no evidence of recurrence in nine months.

The other case was insensitive to irradiation and did not metastasize. A severely destructive lesion, it had invaded the floor of the brain within four months of the first symptoms of nasal blockage. All available tumor was removed, and radium needles were placed intracavitarily in the orbit and antrum. The tumor continued to grow even though 8700 r additional x-ray therapy was given, and the patient died a year after treatment was begun. This tissue was studied by several pathologists.

Malignant melanoma, a tumor of mesenchymal origin, occurs principally in the nasal cavity, primarily either on the septum or on the lateral nasal wall. In my case the primary lesion was on the lower turbinate. Ringertz reported 41 cases, all of which involved the nasal cavity. Probably these tumors originate in the melanin-bearing cells of the nasal cavity. They are usually very radiosensitive, but regional and distant metastasis may occur early, and consequently the prognosis is not good.

SYMPTOMS

Because of the slow-growing nature of these lesions with a paucity of early symptoms, the majority of patients seek treatment in an advanced stage of the disease, the lesion being evident on external or intranasal inspection. In all probability many more early lesions would be found if all clinicians were alert to the vague complaints of pain and discharge from the nose. Too many of these patients have consulted one or more physicians because of a pain in the face or orbit for many months before the diagnosis was clarified by the appearance of swelling or nasal obstruction.

Since malignant diseases of the sinuses have shown a frequency preponderance of about 80% in the antrum, it follows that the majority of patients seeking diagnosis will have symptoms referable to that locality.[22] Many neoplasms are far advanced before presenting any type of symptoms, and those patients are indeed fortunate who have early involvement of areas which will cause pain or swelling. Most patients will present themselves for treatment fairly early after being convinced that something must be wrong.

Undoubtedly pain of some degree is, in the majority of patients, the first symptom experienced. Initially it is vague and of little severity, involving some branch of the first or second division of the trigeminal nerve, and it is often misinterpreted in elderly people, most of whom have dental or neuralgic problems. When pain is the presenting complaint, it is usually described as over the cheek bone or under the eye. Less often the pain begins in the upper teeth or in the eye. According to New, "Patients with constant complaint of some pain or uneasiness in the upper jaw or face of short duration, made worse by lying down, should be suspected."

Paresthesia may be the presenting symptom if there is a destructive involvement of the alveolar or infraorbital nerves. Tumors primary to the ethmoid sinuses most often

produce other symptoms first, and pain comes on rather late. It may be referred to one side of the nose, to one orbit, or unilaterally over the frontal region. In primary tumors of the frontal sinuses, pain is almost always the first symptom; it is a unilateral headache, at first very vague; the patients present themselves rather late after its beginning. Since headache is such a common occurrence, too often investigation of the frontal sinus is not carried out until the tumor is of considerable size.

The next most frequent initial complaint following pain is that of swelling. In involvements of the antrum this may occur in the cheek, in the roof of the mouth, or, less frequently, in the orbit. Swelling in the roof of the mouth may precede any alveolar involvement, but in many cases the teeth become loosened and are then extracted and the tumor follows the root of the tooth into the oral cavity. Frequently in edentulous patients the initial presenting symptom is a tumor mass on the alveolar ridge. Trismus and ankylosis may be encountered in tumors originating in the posterolateral walls of the antrum. Swelling of the orbit with displacement occurs in invasive tumors originating in the antral roof and usually is concurrent with the invasion of the ethmoids and nasal cavity.

External swelling occurs late in primary tumors of the ethmoid labyrinth and is usually the result of destruction of the lamina papyracea, with invasion and secondary infection of the orbit. However, in the majority of cases unilateral nasal obstruction occurs first. Since the anterior wall of the frontal sinus is thin, its destruction, with consequent invasion of the soft tissue of the forehead, is a common late symptom of tumors of this sinus. As already stated, unilateral nasal obstruction occurs initially in the majority of malignant diseases of the ethmoid region and is usually accompanied by anosmia, nose bleed, or sanguinous discharge, but this may also be the initial complaint in malignant diseases primary in the antrum.

Some of these tumors either early or late invade the lacrimal system and produce obstruction by local pressure or tumor invasion. Ohngren [19] feels that tearing in these cases should be investigated early by iodized oil, U. S. P. (Lipiodol) in the tear sac, as these ducts apparently show early changes in ethmoidal tumors.

DIAGNOSIS

From the clinician's viewpoint, the occurrence of swelling or ulceration is most frequently the first sign that malignancy exists. Swelling of the face or intraorally which is persistent and progressive and not purely of infectious origin and ulceration occurring in similar circumstances have long been recognized by physicians and the laity alike as being signs of cancer.

Ulceration occurs fairly early in epithelial tumors, the lesion then presenting an irregular grayish mass with everted edges, very firm and indurated when palpated. Sarcomas may attain large size without ulceration. They are soft and usually reddish in appearance, with a tendency to bleed freely when manipulated. Intranasally they may appear as reddish polyps, conforming to their space in the nose, with little evidence of local destruction, in contrast with the grayish, nodular, ulcerated, and destructive carcinomas. Melanosarcomas and mixed tumors are characteristically bluish in color.

A more frequent use of x-ray by the physician in cases of facial neuralgia and unilateral nasal complaints in middle-aged and elderly persons would lead to much earlier discovery of tumors of the nose and sinuses. When used in advanced cases, its chief value is in the delineation of the growth for the purpose of estimating the operability and type of treatment. Early lesions will show soft tissue changes, with little if any bone involvement, while in more advanced and extensive tumors there may be evidence of displacement, decalcification, and absorption of bony walls. In all probability the tumor will be found to be much more extensive than roentgenological findings will indicate.

Exploration through the canine fossa is justifiable in order to examine a soft tissue mass in the antrum, but one should be pre-

pared to proceed immediately with its removal after laboratory examination of a frozen section.

It has been proved experimentally in animals by a number of workers that injury to a primary tumor can disseminate tumor cells through the lymphatics, and even though most of these cells, spread by traumatization, do not survive the destructive processes of the normal lymph node, precautions should be taken wherever possible to prevent their spread. Ohngren [19] states that

> in a great number of superficial tumors the biopsy excision can be postponed until the pre-operative irradiation treatment has reduced the power of growth of the tumor and facilitated the anti-tumoral activity of the organism itself.

However, he recognizes that biopsy excision is necessary in most cases of tumor of the maxilloethmoid region, but again he prefers this following irradiation or immediately preceding radical electrosurgical treatment. Biopsies may be obtained safely in such advanced tumors as those presenting ulcerative masses in the nasal cavity or alveolus if the cut surface is immediately cauterized by electrocautery, or preferably, if the tissue is removed by an electrosurgical loop.

A single negative biopsy report should not be accepted as final elimination of malignancy in a lesion that has other reasons to be suspected. Chronic infectious processes with ulceration grossly have the same appearance, in most instances, as an ulcerating tumor in direct continuity and association with it, while a smooth swelling can be covered by normal tissue of variable thickness. Therefore, an initial biopsy should be deep into the indurated mass and should be repeated in a new location if reported as free of tumor cells.

The cytological smear technique of Fitz-Hugh, Moon, and Lupton [23] offers the possibility of recovery of desquamated or ulcerated tumor cells from the antrum, a diagnosis thus being established prior to opening the sinus by means of a simple irrigation. These authors have not established the reliability of this test, since the cases presented were well advanced and easily diagnosed by other means.

TREATMENT

Undoubtedly the cure rate of any series of cases is influenced by the individual skill of the surgeon or the radiologist. Only this factor could account for the wide differences in reported results. Certainly the first treatment given has the best chance of curing the patient and should be drastic if necessary. Sacrifice of an eye or jaw is justified if, in the judgment of the surgeon, such a procedure will improve the patient's chance of survival.

The Moure skin incision has been used in the majority of cases in which exploration of the antrum, orbit, and ethmoids was necessary. Ohngren's incision was found adequate where the lesion was limited to the antrum and lower nasal cavity but does not give good exposure of the ethmosphenoid region. The technique of Bordley and Longmire [24] gave excellent exposure in a case of fibroma involving the ethmoids, sphenoid, and cribriform plate bilaterally. Healthy skin is divided by sharp cutting, but where a tumor approaches the skin it is a strict policy to change to electrosurgery.

If it were possible to seal off the blood supply and lymphatics, the actual removal of the tumor would not be too difficult. It is necessary to coagulate each section of tumor, including bone and periosteum, before disturbing it in any way. Only after thorough coagulation is the tissue removed with rongeurs and forceps. Finally, the remaining surfaces are thoroughly coagulated, as well as the lymph-bearing areas of the floor, the lateral wall of the nose, and the lateral wall of the nasopharynx.

Split-thickness skin grafts are placed immediately over exposed dura and over bone and soft tissue that are not in contact with intracavitary radium. Radium needles or capsules are then distributed in the area previously occupied by the tumor as well as in its lymphatic drainage pathways, where they are held in place by packs. After the packs are removed, external irradiation is applied to the primary area and to the high lymph nodes of the neck. After-care consists of

control of infection and the removal of sequestra when sufficiently loosened.

Although the method of treatment varies in individual cases, adherence to these principles has resulted in gratifyingly fewer one- and two-year recurrences. Cases will be presented representing tumors of different grades of malignancy and position, and an attempt will be made to point out the reasons for failure. Criticism is based on experience gained in the treatment of 26 cases of malignant tumors of all types, which will not be reported at this time, since the number is too small and the time insufficient to be of much statistical value.

Of these cases, there were 8 poorly differentiated and 10 well-differentiated squamous cell carcinomas, 2 transitional cell carcinomas, 2 adenocarcinomas, 1 papillary carcinoma, 1 malignant melanoma, and 2 plasmacytomas.

REPORT OF CASES

The first case represents the highly malignant group, not very extensive in growth but one which frequently is sentenced to palliative irradiation.

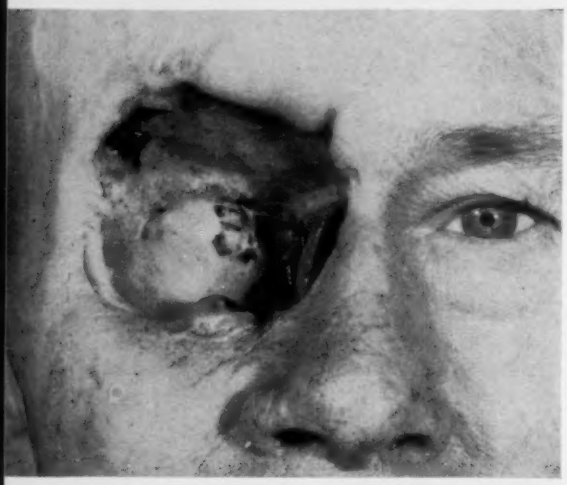
CASE 1.—A 65-year-old white man, admitted March 30, 1951, had no previous history of nose trouble. He had noticed left side nasal blockage for four weeks, with swelling of left side of nose and tearing of the left eye a few days later. For two weeks he had noticed a yellowish nasal discharge. Findings: Swelling, tenderness left side of nose into cheek. Friable, easily bleeding mass, filling left nasal cavity to posterior choana. Biopsy: Transitional cell carcinoma. X-ray diagnosis: Clouding of left ethmoid, antrum, sphenoids, and frontal sinus, with erosion of bone into left orbit. There was no metastasis. Treatment: External irradiation from April 7, 1951, to May 9, 1951, 6600 r through three ports. Treatment caused mass to shrink to less than half original size. Readmitted Aug. 8, 1951, with metastasis of left upper cervical nodes, for which he was treated with three 1.33 mg. and twenty 2.4 mg. radium needles in the left side of neck for one week, with additional 1200 r external irradiation to the left neck. Patient died Oct. 2, 1951, of metastatic lesions in chest.

Radiologists concede that it is very improbable that external irradiation will penetrate the bones and soft tissue of the ethmosphenoid region sufficiently to be curative. Highly malignant epidermoid tumors of this region should be given a grave prognosis, but the chances of cure are much greater if operative exposure is made, with all available tumor removed by electrosurgery, and intracavitary radium is placed at the time of operation. This should be supplemented with external irradiation, including the upper lateral neck. Considering that regional and distant metastases may show up several months after successful treatment of the primary lesion, preoperative irradiation appears to be logical.

The second case represents a group in which purely surgical means were used initially, followed by irradiation to the recurrences.

CASE 2.—A 27-year-old white man developed a right antrum infection in 1945 requiring many irrigations. In 1949 he noticed a swelling of the right cheek, involving the orbit and nasal and oral cavities. He was admitted to a hospital in another state, where the diagnosis of "carcinoma" was made by biopsy. In July, 1949, the right orbit was exenterated along with the anterior and medial wall of the antrum, part of the zygoma, and part of the hard palate. This was carried out with scapel and biting forceps. The patient had no complaints until May, 1951, at which time he developed pain in the operative site, and a hard growth was found on the floor of the antrum. He was then transferred to our hospital. Pathological diagnosis: Anaplastic squamous cell carcinoma. Treatment: Intracavitary radium throughout the operative defect and the nasal cavity. Sequelae: Fixation of the mandible, requiring amputation of the coronoid process. Sequestration and severe pain, requiring alcohol nerve block. End result: Epithelization of cavity, no complaints, no recurrence to August, 1953.

Not knowing the extent of the original lesion, one cannot criticize the extensiveness of the original treatment. At least recurrence was postponed nearly two years. It would appear that the primary lesion was of low-grade malignancy and recurred as an anaplastic carcinoma. Very likely there would have been no recurrence if the tumor-bearing area had been thoroughly coagulated and then irradiated. As a result of the surgery, intracavitary radium was able to reach the second tumor effectively.



Case 4. Tissue loss after consecutive operations.

The third case somewhat resembles the second in that purely surgical means were tried first, with x-ray therapy used in treatment of recurrences.

Case 3.—A 42-year-old white man entered a hospital in another state on April 16, 1949, because of severe epistaxis. History: Tearing left eye, several months. Left proptosis and painless swelling left submaxillary for two months. Had had nasal polyps since 1943. Diagnosis: Transitional cell carcinoma, left ethmoids, antrum, and sphenoid, with invasion of the orbit. Treatment: May 11, 1949, exenteration of the right orbit, ethmoids, anterior and medial wall of the antrum, and anterior wall of sphenoid. Operation by general surgeon, using scalpel and biting forceps. On June 21, 1949, left radical neck dissection and right suprahyoid dissection. Sept. 22, 1949, recurrence in left neck, treated by x-ray with regression. Nov. 29, 1949, nodes in left temple given 1400 r irradiation. Dec. 8, 1949, recurrence, deep node in right neck, treated by x-ray with regression. Patient then transferred to our observation. Had had no x-ray treatment thus far to primary lesion. Biopsies taken from left orbit and sphenoid sinuses positive for transitional cell carcinoma. Treatment: External irradiation, 3000 r through each of three ports to the primary site. External irradiation to upper right neck. Sequelae: Fixation of the mandible, requiring removal of left coronoid process. Sequestra removed from primary site for several weeks. On Dec. 6, 1950, death from intracranial hemorrhage from internal carotid artery, secondary to radionecrosis. No malignant cells found at autopsy.

Again in this instance irradiation was capable of eradicating the malignant growth, but it was also the lethal instrument. Undoubtedly the radiologist was too enthusiastic, since 9000 r is fairly drastic treatment in such a widely exposed cavity. An otolaryngologist is not competent in radiological techniques, but he cannot fail to note that some radiologists appear to give adequate therapy with a minimum of radionecrosis and disturbance of function.

The last two cases are representative of tumors of low malignancy. As has been pointed out, surgery with sharp cutting instruments has little chance of curing any but the circumscribed anterior nasal or antral lesions and then must be by wide excision. The following case is an excellent example of timidity and inadequate understanding of tumor activity.

Case 4.—A white man aged 60 developed a mixed basal and squamous cell carcinoma, Grade 2, in the inner canthus of the right eye, which was

treated by electrosurgery in April, 1948. By June, 1948, it was discovered that the lesion had eroded into the frontal sinus and the adjacent nasal bone. This was removed by sharp dissection. The following March he was readmitted for plastic closure with a forehead flap. The closure was completed by September, 1949. In February, 1950, a recurrence was discovered, involving the right frontal sinus, the cribriform plate, the roof of the orbit, and across into the left nasal cavity. The orbit was exenterated and the remaining tumor removed by curette and biting forceps. In September, 1950, recurrences were discovered in the right frontal, ethmoid, sphenoid, and orbit, which were removed with biting forceps and coagulation. Six weeks later more tumor was removed from the lateral wall and roof of the orbit, exposing more dura, with closure by split-thickness skin graft. Another similar operation was done in January, 1951. In September, 1951, a recurrence was found which had penetrated the apex of the orbit. Only then was it thought necessary to try x-ray therapy. Irradiation has been used recurrently since. The patient was still living August, 1953, but with persistent intracranial basosquamous cell carcinoma.

There is no place in cancer surgery for such nibbling procedures as were followed in this case. Local recurrence, so characteristic of tumors of low malignancy, may be due to seeding of the wound edges in sharp dissection or to lymphatic spread. Either of these possibilities is unlikely if the tumor and lymphatics are coagulated before removal is begun. A chance for better results could have been obtained with much wider initial excision.

The last case is that of an adenocarcinoma which was treated initially by wide resection only. Roentgenotherapy was given too late to prevent local and distant metastases, although the tumor was radiosensitive.

CASE 5.—A 55-year-old white man first noticed a small firm mass in the left upper gum about June, 1947, which continued to increase in size. About six months later, he developed sharp pains under the left eye, with occasional epistaxis. On admission, Aug. 29, 1948, there was a granular, fungating lesion under the left middle turbinate, with a firm mass above the alveolus anteriorly. Pathological diagnosis: Adenocarcinoma. Treatment: Resection, by sharp instruments, of the right alveolus and floor of the antrum including floor of the nose and lateral wall of left nasal cavity. No evidence of recurrence until March, 1951, at which time a painful nodular mass was found on the posterior wall of the antrum, which was positive when biopsied. Further surgical excision revealed extension into the pterygoid fossa. Treatment: Eleven 2.4 mg. radium needles placed in antrum for one week, with additional 7200 r external irradiation to the antrum through three ports. Metastatic lesions were then found in the chest. Following sequestration, the antrum healed with no further recurrence. Patient alive June, 1953, but with continued chest metastases.

Since the adenocarcinoma is normally of low radiosensitivity, great care should be given its removal by wide margin electrosurgery. Only by this method can one hope to eradicate the last viable tumor cell from the area. As for roentgenotherapy, it is never possible to say when it has been used unnecessarily.

SUMMARY

Even though intensive study of cancer has continued for centuries, the only discoveries of value in malignant diseases of the nose and sinuses have been in their histopathology and clinical behavior. Knowledge of these factors was followed by an improvement in management.

Roentgenotherapy alone proved to be only palliative, but when combined with open surgery, better results were obtained. In most cases surgery alone was disappointing. When roentgenotherapy was combined with electrosurgery in large numbers of cases, the cure rate increased convincingly. In the light of these methods, five rather typical cases are presented with an analysis of their treatment for causes of failure.

The methods most satisfactory in the treatment of 26 cases of malignant disease are outlined.

CONCLUSIONS

Malignant diseases of the nose and sinuses are complicated by their anatomical relationship with vital structures.

Management of these tumors necessitates a knowledge of their histopathology and clinical behavior.

Best results have been obtained by combined electrosurgery, intracavitary radium, and external irradiation.

3707 Gaston Ave.

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RADICAL MASTOIDECTOMY WITH PRIMARY SPLIT-THICKNESS SKIN GRAFTING

Survey of Fifty Cases

EDWARD H. CAMPBELL, M.D., Philadelphia

THIS SURVEY of 50 consecutive radical mastoidectomies is presented (1) to reveal certain features of the symptomatology and pathology connected with these chronic ear infections, (2) to emphasize certain parts of the skin-grafting technique, and (3) to present data on the healing time and the results obtained, with emphasis on the hearing before and after operation. Radical operations on these patients were performed only after careful consideration had been given to the possibilities of eliminating the pathology by some modified radical procedure. In several instances operations were started with a modified procedure planned only to discover pathology of a nature that required the more radical operation.

SYMPTOMATOLOGY

All 50 patients gave a history of long-standing pus discharge from the ear. Some patients had had the discharge for 40 years or more, and the persistent drainage, often with a foul odor, was usually the chief complaint. In many the hearing had gradually become worse over the years, and in some cases the hearing loss had become extremely severe. In numerous instances the deafness had reached the extreme degree of the conductive type—approximately a 60-db. loss to the low and middle frequencies. Vertigo was the next commonest symptom, and this was present in a severe degree in nine patients in whom labyrinthine fistulae were found at operation. Pain, either in the ear or in the head, was seldom mentioned, and tinnitus, while present in many, was apparently not a disturbing symptom.

PATHOLOGY

The pathology found in any series of 50 or more chronic middle-ear infections will show a considerable variety. This present survey revealed nearly every imaginable type of pathologic change encountered in such infections. The great majority of the mastoids were of the sclerotic type, with little or no cellular structure present. A few cases, however, showed necrotic cells in the mastoid tip, the sinodural angle, zygomatic area, or the region adjacent to the antrum.

The commonest finding was pus and granulation tissue in the middle ear, epitympanum, and antrum. Some cases, however, showed little or no moisture to be present, but a considerable cholesteatoma and its matrix occupying the attic, antrum, and, at times, the whole middle ear. The pus was scanty in amount except in those cases in which an acute exacerbation of the infection had occurred shortly before operation. This scanty pus was nearly always of the thick, yellowish-white foul-smelling type. When an excessive amount of moisture was present, it was found to contain considerable mucus, obviously draining into the ear from the nasopharynx. The granulation tissue found in the middle ear was usually of the firm type, covering the inner wall of the tympanic cavity. Frequently, however, exuberant soft granulations filled in the hypotympanic area, the antrum, and mastoid cells, when present. It was common to find some fibrous tissue

From the Department of Otolaryngology, University of Pennsylvania Medical School, and the Graduate School of Medicine, the University of Pennsylvania.

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present, resulting from partly or fully organized granulation tissue. The granulations with some fibrous tissue and adhesions and sometimes polypoid tissue frequently covered areas of the middle ear and attic to an extent that recognition of the anatomical structures became difficult. Such alterations increased the difficulties of thoroughly removing all pathologic tissue during the operative procedure. Such thorough removal of all granulation and fibrous tissue, as well as all other pathology, was considered essential as a preliminary to the applications of skin grafts.

Tympanic-membrane perforations found in these cases were of many sizes and shapes and in several locations. At times little or no drum membrane was present. In other cases only small to moderate size perforations were present throughout Shrapnell's membrane. Probably the commonest perforation was the type occupying about one-third to one-half of the area of the drum membrane, chiefly in the posterior part, extending from the annular margin to the malleus handle. Through these perforations could be seen, usually, the granulations, pus secretion, and fibrous adhesions present. In many instances cholesteatoma could be seen extending from the attic area. Frequently sufficient view of the middle-ear area was obtained to determine whether or not there was any necrosis of the incus and stapes present.

Evidence of necrosis of one or more ossicles was one of the commonest findings, both before and at the operation. Such necrosis was present in 35 of the 50 ears operated on. Regarding necrosis of the ossicles, it is usually considered that the incus is the one to become involved first and show the greatest amount of necrosis. It has been my observation that the head and crura of the stapes are usually the first to be involved in a necrotic process, while the incus becomes involved later. When the necrotic process has been of long duration and extensive, the malleus will then become affected, and all these ossicles may entirely disappear. I have observed in many operated on cases that the malleus may be found intact, the incus partly necrosed, and no evidence whatever of the existence of the stapes. Certainly it is obvious, in many cases, that the head and crura of the stapes are not present. Whether or not the footplate of the stapes is present can seldom be determined safely at operation, as it is not advisable to remove every particle of the granulations and fibrous adhesions from this area to expose the footplate plainly to view. The illustrations in textbooks showing the anatomical structures of the middle ear in various stages of the radical mastoid operation nearly always show the incus and malleus well removed but the head and crura of the stapes protruding from the oval window. Writers of articles on radical mastoidectomy have stressed the importance of much care during the operation, to avoid injury to the stapes because of its elevated position. Advice has been also given to avoid using a skin graft to cover the oval-window area for fear of pressure on the stapes' head. It has been my observation that in those cases in which the middle-ear pathology has been of a nature to require radical mastoidectomy that the stapes' head and crura have disappeared from the necrotic process in most instances. It seems only logical to assume that the stapes which occupies a position on the inner wall of the middle ear will feel the effects of the chronic infection, granulation formation, and, perhaps, cholesteatomatous pressure before the incus, which occupies a position in the middle ear elevated from the walls of the tympanic cavity. The malleus is in a still more distant position from the basic pathology in the middle ear, and it is a common observance that the malleus is much less apt to become necrotic than the incus.

Bony necrosis in other parts of the middle ear and mastoid was a fairly common finding in these 50 cases. In three cases the facial nerve had been uncovered in the transverse portion, due to necrosis of the bony covering. In one case the facial nerve had been exposed throughout its transverse and vertical parts. Such cases required extreme care in removing the overlying granulations to avoid injury to the nerve fibers. In some of the patients

bony necrosis had exposed the dura of the middle cerebral fossa and areas of the lateral sinus, and in nine cases had produced a fistula of the horizontal semicircular canal. In one of these there was a fistula present in the superior vertical canal as well as one in the horizontal canal. In one patient there was a fistula present in the horizontal canals of both sides. In this case radical operations were performed on both ears at an interval of five days between them. The presence of the fistulae did not complicate the operative procedure. Any granulations or other material was carefully removed from the fistula area and the skin graft placed over the fistulae as in the fenestration operation. In no case was there any loss of the vestibular function, and in only one case was there a severe vertigo produced such as occurs after the fenestration operation. In eight of the nine ears with labyrinthine fistula present, a positive fistula test was obtained at the examinations before operation.

One of these radical mastoid operations was performed in a case of glomus jugularis. The tumor was removed as thoroughly as possible from the hypotympanum and jugular bulb area. This area was firmly packed with paraffin mesh gauze to control the bleeding, and the balance of the middle ear and excavated mastoid was covered with the split-thickness graft. The grafts made a primary take, and the gauze packing was gradually removed during the two weeks following operation. At office visits subsequently this jugular-bulb area was cauterized severely with a saturated solution of trichloroacetic acid, with the idea of destroying as far as possible any tumor tissue remaining and to encourage fibrosis in that area. Within two months after operation this area was healed and covered over with skin. Further observation during the two years since operation has shown no evidence of return of the tumor.

The pathology in these 13 patients who had had some type of mastoid operation previously was of a somewhat different character. Eight of these previous operations had been incomplete radical mastoidectomies. In all of them pus had continued to discharge from the ear, granulations had accumulated, and fibrous tissue had partly filled in the middle ear. In 10 of the ears, the Eustachian tube was patulous and mucopus was present in the area adjacent to the tubal orifice. Two of the patients had large postauricular fistulae, with pus discharging both from the ear and from the fistula. In only 2 of these 13 patients was cholesteatoma found. In several others partially necrosed ossicles and drum remnants were found, indicating how incomplete the previous operations had been. Unexenterated mastoid cells filled with granulations and pus were also found as well as exposed dura, lateral sinus, and facial nerve.

The completion of the radical mastoidectomies in these previously operated on patients presented a somewhat more difficult problem than a primary radical procedure. As part of the operation it was necessary to close the postauricular fistulae in the two cases. The removal of the dense fibrous tissue partly filling the middle ear was a difficult and rather precarious procedure in two of the patients, due to distortion of the landmarks. All of these 13 radical revisions healed promptly after operation and split-thickness skin grafting, and resulted in dry ears and closed Eustachian tubes within six weeks to three months.

OPERATIVE TECHNIQUE

All 50 of the radical mastoidectomies were performed through endaural incisions. With this approach the advantages that have been emphasized elsewhere were found to apply not only to the thorough removal of all pathology from the middle ear but to extensive exenteration of remote mastoid cells and to repair of the postauricular fistulae. The operative procedure did not follow in detail any previously described technique. In brief, the procedures carried out were the following:

1. The three-stage endaural incision of Lempert. No attempt was made to preserve the skin of the posterior auditory canal, as complete covering of the operative area by split-thickness skin grafts was planned.

2. Exposure of mastoid antrum by means of the dental drill and cutting burrs directly through the outer mastoid cortex and underlying bone.

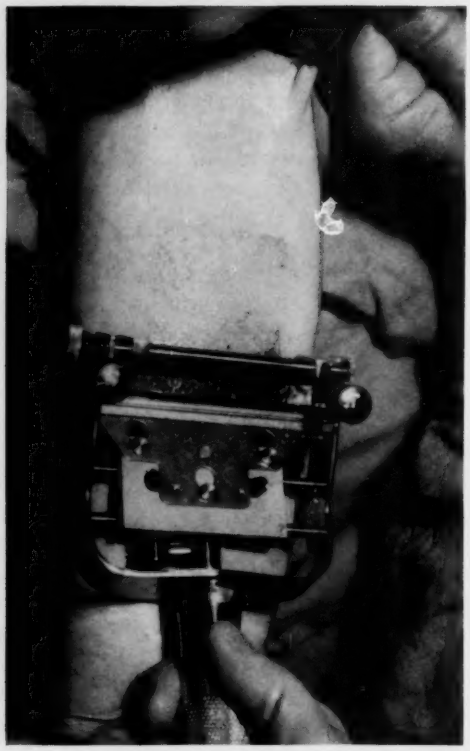


Fig. 1.—Application of the Brown electrodermatome to obtain skin grafts (from the upper arm).

3. Complete removal of all mastoid cells. Great care was taken to follow up any defects in the bone, by burr or curette, that might lead to remote cells or necrotic bone.

4. Removal of the membranous and bony posterior canal walls with lowering of the facial ridge to the level of the horizontal semicircular canal and widening of the aditus to the greatest possible degree.

5. Removal of all remnants of the tympanic membrane and contents of the middle ear. This included all granulations and fibrous adhesions, the malleus and incus if present, the head and crura of the stapes if present, any cholesteatoma and its matrix, the tensor tympani muscles, and, particularly, all material in the hypotympanum. This thorough removal of middle-ear contents resulted in a smooth shiny appearance of the inner wall of the middle ear, a smooth flat surface in the oval-window area, with no protrusion of the stapes' head and crura, a distinct view of the round-window niche, and the white outline of the horizontal portion of the facial canal showing plainly in front of the horizontal semicircular canal.

6. Removal, with the burr, of the bone overhanging the hypotympanum, and other prominences of the annulus tympanicus.

7. Scraping of the tympanic mucosa and soft tissue adjacent to the Eustachian orifice forward into the mouth of the tube for a short distance only. In this way a small mass of tissue more or less filled the Eustachian-tube entrance and formed a partially solid base on which to place the skin graft. No attempt was made to force the soft tissue into the Eustachian isthmus region in an attempt to close the tube at that point.

8. Application of split-thickness skin grafts to the entire operative area, as described in some detail below.

SKIN-GRAFTING TECHNIQUE

Following the completion of the radical mastoidectomy, as outlined above, the entire middle ear and mastoid cavity is lightly packed with gauze soaked in epinephrine, 1:1,000. The region selected for removal of the skin graft is then prepared. I have found that the most accessible and desirable area for removal of the skin is the inner surface of the arm on the same side as the ear operated on.

Fig. 2.—Appearance of arm after removal of split-thickness graft.

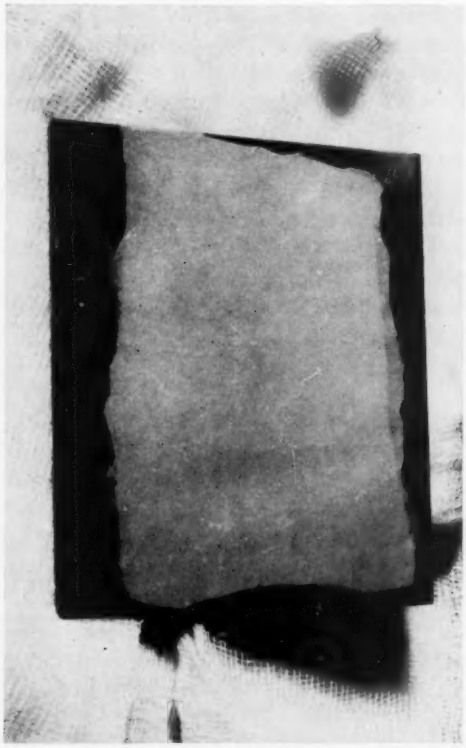
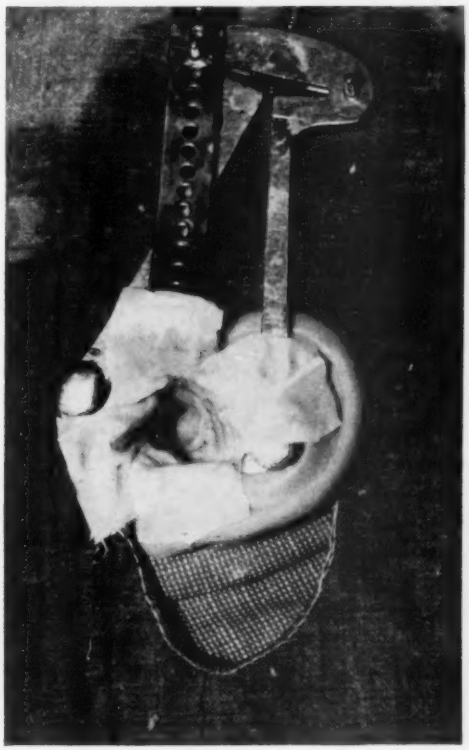


Fig. 3.—The removed split-thickness skin graft is placed on fine-mesh gauze or surgical rayon. It is then cut into four strips of equal width.

This is the side opposite the location of the anesthetist and his apparatus. The arm is drawn out to a position at right angle to the body. An assistant twists the forearm to expose the inner surface of the arm from the axilla to the elbow. This region is practically hairless and produces a fine-textured skin. This whole area has been previously prepared by shaving the hair from the axilla, cleansing with antiseptic soap, an application of 70% alcohol, and covering it with a sterile dressing.

After the arm is properly exposed the area is again treated with soap and alcohol. Sterile liquid petrolatum is then applied to the skin surface, and a rectangular section of skin approximately 3 in. (8 cm.) wide and 4 in. (10 cm.) long is removed from the surface half way between the axilla and the elbow. Considerable care is taken to have this split-thickness graft as thin as possible and in one rectangular piece. This can be easily and quickly done with the Brown electrodermatome. When a dermatome is not available, very satisfactory grafts can be obtained by using an open-faced razor. With the latter instrument, however, there is some difficulty in obtaining the graft in one rectangular piece. This section of skin, with the epidermal surface down, is then placed on a piece of fine-meshed gauze, such as bandage material, or on a layer of rayon, soaked in isotonic sodium chloride solution. The skin is smoothed out on the cloth, to which it adheres firmly. The gauze or rayon is then cut exactly to the size of the skin graft. This rectangular graft on the cloth is then cut crosswise into four strips, each approximately 1 in. (3 cm.) wide. While this graft is being prepared by the assistant or nurse, the arm is bandaged over a petrolatum (Vaseline) gauze dressing and replaced along the side of the table. The epinephrine gauze packing in the ear and mastoid region is next removed, and it is found that the operated on area is free of bleeding after the 10- to 15-minute action of the epinephrine. A self-retaining retractor is again loosely placed in the ear to expose the cavities. The four strips of skin graft on gauze or rayon are then placed carefully so as to completely cover every particle of bone and auditory canal. These strips overlap in the middle-ear area and, to a less extent, along the sides of the operative area. This overlapping is desirable, as it assures that every

Fig. 4.—The four strips of skin graft are placed in the ear and mastoid cavity to completely cover all bone and soft tissue. The cavity is then firmly packed with paraffin-mesh gauze rolls soaked in antibiotic ointment.



square millimeter of bony or soft-tissue surface is covered by the graft. In placing them in the middle ear, great care is taken to press the grafts firmly into the Eustachian orifice, and firmly over the oval window, the round window, the hypotympanum, the epitympanum, and the aditus area. If the facial nerve, the dura, or lateral sinus has been exposed, these areas are covered with the grafts, as are the bony and soft-tissue areas. A labyrinthine fistula, when present, is covered in the same way. When the grafts are properly in place, they are pressed firmly against the bone and soft tissue by small rolls of paraffin mesh gauze. This particular feature is very important in order to assure firm contact of the graft with the Eustachian orifice and the two windows. The entire cavity is filled firmly with the paraffin mesh gauze. In the past two years I have found it advantageous to soak this gauze in an ointment containing polymyxin B sulfate and bacitracin. When the packing has been completed, it will be found that the ends of the grafts protrude slightly from the auditory opening, but this is desirable in order that all raw surfaces at the outer edges of the auditory canal will be completely covered.

POSTOPERATIVE CARE OF THE OPERATED ON AREA

The gauze packing in the ear is not disturbed for several days. Then a few of the outer gauze rolls can be removed, but the remainder of the packing is permitted to remain for 7 to 10 days. When the packing has been removed, there is still present in the cavity the strips of rayon or gauze on which the skin grafts had been placed. These will gradually detach themselves from the underlying grafts during the next two or three days and can then be picked out without danger of loosening any of the grafts adhering to the bone or soft tissue. During the next two or three weeks the part of the skin grafts which have overlapped the other grafts will slough away and can be wiped or picked out easily.

Since the use of the paraffin mesh gauze rolls soaked in the antibiotic ointment, it has been found that there is little or no pus discharge and usually no odor from the operative area after the operation. In the great majority of cases all the grafts make a primary take and no raw areas are present and no formation of granulations. Occasionally a small section of the graft does not survive, and in such cases there is usually formation of granulations in those areas and some seropus discharge for a short time. In such cases it is a good plan to burn down the granulations with trichloroacetic acid and have the patient use antibiotic or antiseptic drops in the ear. In rare instances these granulations persist for months. If the ear has not become completely dry after six or eight months, it is usually an indication that the pathology had not been completely eliminated at the operation or that the Eustachian tube had not been closed off.

COMMENT ON SKIN GRAFTING

Skin grafting of radically operated on mastoids has been used by a few otologists for many years, but no great interest has been shown in this procedure until a few years ago. In 1949 articles by Lempert,[1] House,[2] and Farrior [3] appeared in the medical literature describing techniques for temporal bone surgery with skin grafting. Their methods of obtaining and using the grafts differed somewhat. Lempert used the small section of the skin of the posterior auditory canal wall removed by his endaural incisions, and supplemented this graft with split-thickness skin, if necessary, to cover the desired area. House advocated the use of a very thin full-thickness elliptical skin graft, measuring 1.5 by 3 cm., taken from the postauricular area. He made multiple punctures through the skin to permit drainage of blood and serum. He cut the graft into three portions and placed one piece over the promontory and Eustachian orifice, one over the epitympanum and dural plate, and one piece over the sinodural angle area. Farrior described in detail his skin-grafting technique. He obtained a split-thickness graft from the thigh and covered nearly all the mastoid and middle-ear areas. He stressed the importance of not placing the grafts over the oval and round windows.

In the past two years other articles have been written emphasizing skin grafting and the techniques of using them. In 1952 Zwerling [4] reviewed the literature on skin grafting

of radical mastoid cavities and described the advantages of the Brown electrodermatome in obtaining the split-thickness grafts. In 1953 Adin and Corgill [5] described various methods of closing the Eustachian tube in radical mastoidectomies, and reported good results in 23 operations in which they packed into the Eustachian orifice a section of bone removed from the iliac crest of the patient. They used a split-thickness skin graft to cover the area as well as the remainder of the operated on area. Williams [6] later, in 1953, reported satisfactory results in using split-thickness grafts in 14 radical mastoidectomies. He described in detail his method of removing the grafts and placing them in a single conical-shaped graft into the excavated mastoid and middle-ear cavities.

Recently an article of Harris and Meadows [7] reported much success in the use of split-thickness grafts in 150 mastoid operations, either radical mastoidectomies or fenestration operations. They described the technique of obtaining the grafts with a straight razor, and gave experimental proof that the grafts remained viable and grew.

It is apparent that the popularity of skin grafting mastoid cavities is growing. Any operator who has given this procedure a thorough trial can not help but be impressed by the results obtained. The advantages may be listed as follows: (1) prompt healing of the treated area, resulting in a dry ear in six weeks to three months; (2) prevention of the filling-in of the middle-ear area by granulations and, later, fibrous tissue; (3) more certain closure of the Eustachian tube; (4) preservation of the hearing to a greater extent; (5) prevention of narrowing of the auditory meatus.

A disadvantage may possibly be present in the additional time the obtaining and insertion of the grafts will consume. After a reasonably good technique has been established, this additional procedure adds only approximately 15 minutes to the operating time. Taking this extra 15 minutes at the operating table will save the patient many trips for postoperative care and save the surgeon hours of postoperative treatment.

Review of the literature concerning mastoid skin grafting indicates a variety of methods of obtaining and applying the grafts by various otologists, with perhaps equally satisfying results. Experience has shown, however, that many operators have tried at one time or another skin grafting of mastoid cavities and have abandoned it. In seeking the reason for this attitude, it seems apparent that the chief cause of failure in their hands has been the lack of care and time taken in obtaining and placing the grafts. With the older methods of removing the grafts with a straight razor some skill was necessary to obtain grafts of the proper size and thickness. To develop this skill would take repeated trials, many of which would be failures because of improper grafts or the improper insertion of them. With the electrodermatome no skill or experience in removing the grafts is necessary, but only a knowledge of how to set the instrument for the size and thickness of skin desired.

The art of placing the grafts properly in position is quickly acquired and needs only the deftness and patience that a skilled temporal bone surgeon has already acquired. The manipulation of the grafts is facilitated considerably by the method of placing the skin on fine-mesh gauze or, preferably, on surgical rayon. It does not seem necessary, to me, to perforate the skin grafts to allow the escape of blood or serum. When epinephrine packing is placed in the operated on area for 15 minutes before applying the grafts, very little blood is present. When the grafts are packed firmly against the bone and soft tissue by paraffin-mesh gauze rolls, any moisture under the grafts is pressed out, permitting firm adherence of the grafts to the underlying structure. The incomplete covering of the mastoid and middle-ear areas by the grafts has not been conducive to the best results in my hands. Those operated on ears which have taken beyond the two-month period to become dry have been the ones in which one or more small areas have formed granulations. This may have been due to some devitalized area of the graft where it has not taken, but it is more apt to have been

due to improper placing of the graft, which permitted a gap between the edges, thus exposing bare bone or raw soft tissue. It has been my experience that granulations always accumulate in such areas, and, in spite of intensive postoperative treatment, it is at times extremely difficult to induce skin to grow over these areas. The discharge from the ear continues until the infection has cleared up and the unhealed areas have epidermized.

The presence of severe infection of the middle ear and mastoid and the most complicated pathology present are not contraindications for skin grafting of the cavity. The essential feature is the thorough removal of all such pathology from every part of the middle ear, and mastoid areas. While there appears to be some advantage in permitting the cholesteatoma matrix to remain in those operations in which skin grafts are not used, it has been my policy to remove every particle of matrix in this series of mastoidectomies preliminary to the insertion of the split-thickness grafts. Even when cholesteatoma and matrix have been found covering a labyrinthine fistula, this material has been thoroughly removed without interfering with the function of the semicircular canal involved. In some of the cases in which the pathology has been particularly severe and complicated, it has been surprising to observe how well the grafts have adhered to the underlying structures, whether smooth bone, dura, lateral sinus, facial nerve, or fistulae. In the most severe of these infections I have seen no sloughing of the grafts that I would attribute to the infection itself. The use of the antibiotic ointments in packing the cavities has undoubtedly been of considerable help in preventing damage to the grafts by the infections always present in these cases.

HEALING TIME AFTER OPERATION WITH SKIN GRAFTING

One particular part of the survey of these 50 radical mastoidectomies has been an investigation of the healing time, that is, the time between the operation and the complete healing of the entire area operated on. The cavity cannot be considered to be really healed until the entire operative area has become covered with skin, until there is no moisture whatever present, and the Eustachian tube has been closed, so that contamination of the cavity from the nasopharynx cannot occur. The time required for such complete healing varies somewhat. When all the skin grafts have made a primary take and there have been no gaps in the covering of the operated on areas, the cavity is healed and dry in approximately six weeks after operation. If there has been incomplete covering of the treated area with the grafts, granulations will form in these uncovered spots and a seropus discharge will persist until squamous epithelium covers over all such raw areas. In some cases these granulations reduce quickly and the ear becomes dry and healed within 7 to 10 weeks. At other times the granulations persist for several months, but with active treatment of such cavities epidermis eventually covers all raw areas and the ear becomes dry. In those cases in which the pathology has not been completely removed at operation, the granulations and associated serous or pus discharge may persist for many months or perhaps indefinitely.

The skin covering the middle ear and mastoid cavities is of a delicate type for several months after operation and requires very gentle handling. Any forceful manipulation in these cavities may cause the skin to break down, with formation of granulations and recurrence of the serous or pus discharge. Even without any manipulation of the skin surface, small areas of the skin may break down spontaneously and give a persistent discharge. The delay in the healing in some cases is probably connected with a basic skin hypersensitivity suggesting a skin allergy. These cases act very similar to eczematous dermatitis of the auditory canal, producing a moist irritated skin surface, with, at times, a breaking down of the epidermis and formation of granulations. I have seen such operated on ears a number of times, and it is my impression that they respond better to one of the hydrocortisone ointment prep-

arations than anything I have previously used.

In the great majority of ears operated on the skin covering the cavities gradually becomes firmer and tougher and when this skin becomes covered with a normal amount of cerumen its resistance to external influence is considerably increased. Such ears require no unusual protection and usually water, got into the ears during bathing, produces no irritative effects.

In this series of 50 radical mastoidectomies with skin grafting the healing time showed some variation. Forty-three of the ears were dry and healed within eight months after operation. The average time of healing in these 43 ears was four months. The shortest time for healing was six weeks, and there were four of the ears that were healed in this minimum time. Fourteen additional ears were healed between the second and third months after operation. The balance of the 43 ears were healed between three and eight months after operation.

The reason for the delay in healing in these cases beyond the two- or three-month period appeared to be connected with faulty application of the skin grafts. Most of these were among the earlier cases in which a completely satisfactory skin-grafting technique had not been developed. In general, the healing time will vary within a few weeks, depending on the care with which these grafts are applied into the operative cavities.

The reasons for failure of the remaining 7 ears (of the 50 ears operated on) to become dry and heal within a reasonable time were somewhat difficult to determine. The treated ears of two patients have not become dry after two years and four years, respectively. In both of these, the Eustachian tubes are still open, and it seems reasonably certain that these ears remain moist because of frequent contamination from the nasopharynges. One ear continued to discharge seropus and showed excess granulations for one year and a half. It then became dry and healed and has remained so. Another ear has shown large granulations and pus discharge for 14 months. This ear has not responded to various antiseptics and antibiotics, and the cause is probably incomplete removal of the necrotic bone at the operation. One ear gave a persistent discharge for three years but has been entirely dry and apparently healed for the past six months. Another patient, in whom both ears were operated on at an interval of one year, still has a scanty discharge from one ear after two and one-half years and from the other after one year and six months. There is reason to believe, in this patient's ears, that a skin sensitivity is the basic cause of the continued secretion.

It was previously mentioned that 35 of the 50 operated on ears showed at operation bone necrosis, and of these 35 ears, 23 showed cholesteatoma in addition to the necrosis. Study of the healing time in these 35 ears indicated that this type of pathology did not extend the time of complete healing beyond the average of the whole group. The same applied to those nine ears in which a labyrinthine fistula was found at operation and also in those 13 patients in whom the radical mastoidectomy was a revision of a previous simple or attempted radical operation.

RESULTS OF THE OPERATIONS FROM THE HEARING STANDPOINT

Considerable misconception is prevalent regarding the status of the hearing following radical mastoid operations. It is not uncommon to find mention in the medical literature of considerable improvement of hearing after radical operations and, at times, improvement to an unreasonably good hearing level. For a time, in my earlier radical operations, it was of some concern to me to find that I was not obtaining the improvement of hearing after operations that I had been led to expect from a review of certain other operators' results. After further experience, however, my consistently poor hearing results induced me to view, with much skepticism, the wonderful improvement of hearing obtained, after radical mastoid operations, by some of my colleagues.

An analysis of the anatomical changes in the hearing mechanism resulting from a radical mastoid operation will indicate the

reasons why it is practically impossible to obtain hearing to any reasonably good level after operation. Interruption of the ossicular chain alone would produce 25 db. or more loss of hearing. The obliteration of the tympanic cavity would result in further loss of hearing. Fibrosis around the oval and round windows or the comparatively thick skin covering these areas would contribute still further to a conduction loss. It is difficult to see, therefore, how better hearing than approximately a 50-db. loss could be present after such drastic alterations of the conducting mechanism. An exception to this degree of hearing loss after operation is noted in certain of those ears that do not become completely dry after operation. The presence of moisture at the oval or the round window or other foreign material in these areas may produce an amplifying effect and permit retention of hearing somewhat better than the 50-db. loss. It is a rather common experience for patients suffering with chronic suppurative otitis media to experience a moderate fluctuation of the hearing due to the shifting of fluid in the middle ear. Those patients having short periods of freedom from ear discharge will often state that their hearing is better when the ear is discharging. In those operations which are completely successful in producing dry ears, the amplifying effect of moisture at the windows will not be present to give the improved hearing.

It is obvious, therefore, that a hearing loss of at least 45 to 55 db. can be expected after a successful radical mastoidectomy. The pathology present that necessitated the operation may already have altered the conducting mechanism to the extent of producing a conduction deafness up to 60 to 65 db. In addition, there may be present further loss of hearing due to effects on the perception apparatus. It is logical to theorize that in those ears having a preoperative loss of less than 45 db. the operation will produce a further loss of hearing. In those ears that have a conduction loss greater than 55 db. before operation, the radical operation may improve the hearing to approximately the 50-db. level by the surgical removal of the pathology that was producing a conduction loss greater than that ordinarily associated with interruption of the ossicular chain and obliteration of the tympanic cavity. When the preoperative hearing is between 50 and 60 db. loss, as is very frequently the case, radical operation should produce little or no change of the hearing in the great majority of cases.

In my own experience with radical mastoidectomies these are exactly the results that have been obtained. In general, those patients with a mild to moderate preoperative loss of hearing have had further loss after operation. Some of those patients with severe conduction loss before operation have obtained some improvement of hearing; and most of those patients with a 50 to 55 db. preoperative loss have shown no change of hearing after operation.

PREOPERATIVE AND POSTOPERATIVE HEARING IN CASES WITH OPERATION

A study of the hearing before and after operation in the 50 radical mastoidectomies shows the general trend to be as outlined above. In the Table is recorded the decibel loss of hearing before and after operation in 43 individual ears. Postoperative hearing records were not obtained in seven of the patients. The patients have been placed into three groups: One group is composed of those patients in whom there was no change of hearing after operation from the preoperative level. The second group shows those patients in whom the hearing was worse after operation. The third group indicates those who obtained some improvement after operation. Unless there had been more than a 10-db. change of the hearing before and after operation the hearing is listed as unchanged.

The records indicate that the hearing was unchanged after operation in 29 of 43 patients, was made worse in 9 patients, and was slightly better in 5 patients. In no instance was the hearing improved to a practical hearing level, and such improvement cannot be expected when such changes in the hearing mechanism have been produced

either by the pathology present or in the operation itself.

The failure to improve the hearing, and even the occasional further loss of hearing after operation, has not been disturbing to the patients in my experience. Their particular interest is in obtaining a dry ear, and this can be more quickly and more surely obtained by skin grafting radical mastoid cavities.

OPERATIVE COMPLICATIONS AND POSTOPERATIVE SEQUELAE

The results obtained in radical mastoid operations may be considered in reference to the following:

1. The elimination of the pathology present in the middle ear and mastoid.
2. The establishment of a healed and dry ear, with no tendency toward recurrence of ear discharge.
3. The preservation of the hearing as far as possible.
4. The avoidance or minimizing of operative or postoperative complications.

In this presentation some consideration has been given to the first three of these items, and the results from these standpoints evaluated in 50 operated on cases. A brief discussion of complications in these operated on patients will serve to picture some of the disturbances that may be associated with the pathology present or the operative procedures.

No serious or dangerous complications occurred in the operation of these 50 patients. The complications that did occur were of a minor nature and can be listed as follows:

Perichondritis in one patient
Temporary facial paralysis in two patients
Severe postoperative vertigo in one patient
Postoperative sense of unbalance in three patients
Delayed healing—more than one year—in seven patients

The perichondritis that developed in one patient after operation was not of the severe destructive type. It was noticed at the first dressing after operation and progressed to a moderate extent in the upper third of the auricle. The infection was slow to localize, but finally pus was released from the upper outer surface of the auricle and following this the inflammation slowly subsided. A slight deformity of the auricle was present after the ear had fully healed.

In two patients facial weakness started a day or two after operation and progressed to complete facial paralysis within the next three or four days. In both of these cases the facial nerve had been found exposed in the transverse portion as a result of the necrotic process. Surgical manipulation in this area had resulted in some trauma to the nerve sheath. In one patient the facial function began to return in three weeks after operation, and at the end of two months the function had been completely restored. In the other patient the paralysis was complete for two months. Then function began to return, and during the next three months about three-quarters of the facial function was restored.

The severe postoperative vertigo occurred in one patient in whom a fistula was found in the horizontal semicircular canal at operation. Cholesteatoma covered this area firmly, and the removal of its matrix apparently produced the irritation of the labyrinth. The patient vomited a great deal during the three days following operation and was very dizzy for a week. The vertigo gradually subsided, however, and the patient was able to walk freely in 10 days. Equilibrium was not fully restored for six to eight weeks. It was thought for a while that the labyrinthine function had been destroyed on the side operated on, but in the subsequent postoperative treatments of the operative area a very active fistula response was always produced.

Three additional patients had some mild vertigo for a few days after operation, but all of these were out of bed in two days and discharged from the hospital in one week. The reaction in these three patients was very similar to that experienced by all patients receiving the fenestration operation for otosclerosis.

Delayed healing in seven patients was the most disturbing of the complications. This has already been discussed to some extent,

and the contributing causes may be summarized as follows:

1. Failure to completely cover the operated on area with the skin grafts
2. Failure of small areas of the graft to survive
3. Failure to completely remove the pathology present in the middle ear and mastoid
4. Failure to close the Eustachian tube
5. Breaking-down of the skin in small areas of the cavity due to reinfection or perhaps to skin allergy

SUMMARY

In these patients (50 ears) who received radical mastoid operations the symptoms were chiefly long-standing purulent discharge and loss of hearing. Vertigo was present in nine patients. Pain and tinnitus were not prominent symptoms.

The pathology found at operation was of considerable variety, consisting of mastoid sclerosis, necrosis of bone in various areas, presence of pus, granulations and polypoid tissue, many types of tympanic perforations, adhesive formations, cholesteatoma in 23 cases, fistulae of the semicircular canals in 9 cases, and the presence of a glomus jugularis tumor in 1 case. It was observed that the head and crura of the stapes had necrosed away in many of the cases before the incus and malleus had become necrotic.

In the operative technique emphasis has been placed on the very thorough removal of all pathology in the middle ear and mastoid, and a special procedure to attempt closure of the Eustachian tube.

Details of the skin-grafting technique are presented. A split-thickness skin graft was removed from the upper arm, with either the Brown electrodermatome or a straight razor. The graft was placed on fine mesh gauze or, preferably, surgical rayon, cut into four strips, and these strips then placed in the ear and mastoid cavity, so that every square millimeter of the excavated mastoid, middle ear, and auditory canal was covered with skin graft. The grafts were held firmly in place by rolls of paraffin mesh gauze soaked in antibiotic ointment. The following advantages were noted in this primary skin-grafting technique: Prompt healing of the operated on area in nearly all cases, prevention of filling-in of the middle ear with granulations and fibrous tissue, more certain closure of the Eustachian tube, preservation of the hearing to a greater extent, and prevention of narrowing of the auditory meatus. It was found that the most extensive pathology of the ear and mastoid was not a contraindication for the use of the primary graft.

In this series of 50 ears, the area operated on became dry and healed in a variable time.

Hearing Loss Before and After Operation in Forty-Three Ears

Patient	Hearing Before Operation, Decibel Loss to Frequencies 128-2048 Cps	Hearing After Operation, Decibel Loss to Frequencies 128-2048 Cps
Cases Showing no Change of Hearing		
M. B.	Nearly Total Deafness	Nearly Total Deafness
R. A.	45 to 60	50 to 65
H. A.	55 to 60	40 to 60
V. B.	45 to 60	40 to 55
M. B.	50 to 65	45 to 55
M. C.	55 to 60	55 to 65
F. K.	50 to 60	55 to 65
J. F.	50 to 65	60 to 70
E. G.	55 to 70	60 to 70
A. G.	55 to 70	55 to 60
T. K.	40 to 50	40 to 50
H. L.	50 to 70	45 to 60
D. M.	35 to 45	35 to 45
M. M.	35 to 45	35 to 50
H. Mc.	45 to 60	45 to 55
F. N.	50 to 80	50 to 80
E. M. (rt. ear)	50 to 65	50 to 65
E. M. (lt. ear)	45 to 60	50 to 60
C. N.	70 to 80	70 to 80
W. O.	35 to 45	45 to 50
W. S.	40 to 50	40 to 45
B. S.	40 to 50	40 to 60
J. S. (lt. ear)	30 to 45	40 to 55
V. Y.	50 to 75	50 to 75
E. W.	45 to 55	45 to 60
A. K.	50 to 65	40 to 65
L. T.	50 to 60	50 to 60
D. L. (rt. ear)	35 to 50	35 to 60
D. L. (lt. ear)	45 to 60	45 to 50
Cases Showing Hearing Worse After Operation		
M. B.	25 to 35	45 to 50
A. B.	20 to 35	60 to 70
R. D.	40 to 45	50 to 60
L. F.	10 to 20	20 to 35
H. F.	40 to 50	60 to 70
H. G.	35 to 50	70 to 75
E. K.	45 to 50	55 to 70
M. N.	50 to 60	80 to 90
S. V.	20 to 30	30 to 50
Cases Showing Better Hearing After Operation		
S. E.	40 to 60	30 to 45
M. M.	40 to 50	25 to 45
M. M.	50 to 60	35 to 50
A. M.	70 to 100	45 to 60
J. S. (rt. ear)	70 to 100	40 to 55

Forty-three of the ears were healed in an average of four months. Seven ears of the 50 showed some discharge after one year, all but two of these eventually became dry and healed.

The results from the hearing standpoint are emphasized. Hearing records were obtained before and after operation in 43 of the treated ears. The hearing was unchanged in 29 instances, was made worse in 9, and slightly improved in 5. Explanations and comments on the hearing results are presented, and the opinion is given that hearing better than a 50-db. loss could not reasonably be expected after a successful radical mastoidectomy. A Table showing the hearing loss before and after operation in each of the 43 cases is presented.

A brief discussion of complications encountered in these operations is presented. These consisted in perichondritis in one patient, temporary facial paralysis in two patients, severe postoperative vertigo in one patient, and delayed healing (more than one year) in seven patients. Delayed healing (beyond three or four months) was attributed to failure to completely cover the operative area with the grafts and failure of small areas of the graft to survive. Healing delayed longer than a year was attributed to failure to completely remove the pathology in the middle ear and mastoid in two or three cases, failure to close the Eustachian tube in two cases, and the presence of a skin allergy in two cases.

133 S. 36th St. (4).

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PERFORATIONS OF RESPIRATORY AND ALIMENTARY TRACTS BY METALLIC FOREIGN BODIES

W. B. FINERMAN, M.D., Los Angeles

FOREIGN bodies in the air and food passages are quite common, such that no endoscopist's office is complete without a dramatic display of fascinating objects he has recovered from them during his medical career. Ellen Patterson,[1] in a review of the literature regarding such foreign bodies, reports that the earliest recorded case treated successfully is attributed to Nicholas Habicot, who, in 1620, performed a tracheotomy to relieve the incident suffocation. The objects involved were nine pistoles wrapped in a cloth, swallowed by a 14-year-old boy in imminent danger of being robbed of them. Habicot, being unable otherwise to extract these coins, forced them into the stomach by means of a lead probe, whereupon they progressed in the usual manner. In the same article is a note on the first recorded case of tracheotomy for removing a foreign body. Verdue,* in his "Surgical Pathology," published in Amsterdam in 1717, described the removal of an inhaled fragment of bone from the trachea by sectioning between two of its rings.

Frequently recorded are foreign bodies remaining in the stomach or lungs for months or years. No discussion on such foreign bodies is ever complete without anecdotes of peripatetic needles cached in some portion of the body which months or years later appeared in some distant part. While Jackson [2] estimated that less than 2% of retained foreign bodies in the lungs are coughed up, tempered procrastination in the operative removal of alimentary foreign bodies has been justified by Jackson, Clerf, Vinson, and a host of others.

The purpose of this paper is to present a case in point of multiple metallic foreign bodies in the respiratory and alimentary tracts of an infant, with the sequelae.

* Cited by Gross.[2]

REPORT OF A CASE

A 12-month-old Mexican child (A. M.) was admitted to the contagious section of the Los Angeles General Hospital, with the diagnosis of possible dysentery. Essentially, the history was the sudden onset two weeks before admission of daily vomiting, dark bloody stools, anorexia, and nonproductive cough, continuing until admission to the hospital. There had been no previous illness. Two siblings were in good health. There was nothing pertinent in the infant's past history or in the family history.

Physical examination disclosed an emaciated, dehydrated, irritable, Mexican boy of one year. Rectal temperature was 101.4 F; pulse rate, 180; respiration rate, 40. His face was scratched; there were multiple bruises of the extremities; his trunk showed extensive areas of ecchymoses but no true petechiae. Some dry scaling of the scalp was present. His pupils were round, regular, and equal and responded to light. A thick serous discharge hung from the nose; his lips and tongue were dry; the pharynx was dry and diffusely reddened. Both drums were lusterless, but otherwise the normal markings were present. No stiffness of the neck was found. The chest was resonant to percussion; the breath sounds were well heard, but some fine crepitant rales were noted in the lower lobe of the left lung. The heart tones were rapid but of good quality. His abdomen was soft and scaphoid, and no masses were palpable. There was no apparent abdominal tenderness, and peristalsis seemed within normal limits. Some excoriations of the base of the penis were seen. His extremities showed no limitation of motion and were not tender to pressure; reflexes were all present and active. The skin, in addition to the scratches and ecchymosis noted above, was very dry and poor in tonus. A blood cell count done on admission showed a hemoglobin of 80% and a white blood cell count of 11,120, with 67% polymorphonuclear cells, 3% eosinophiles, and 30% lymphocytes. Urine samples could not be obtained for some days.

A tentative diagnosis of left lower lobe pneumonia with malnutrition and dehydration was made. Because of the child's condition antibiotic therapy with immediate measures to restore fluid and caloric balance were begun before x-rays were taken. Thus it was not until three days later that the startling x-rays shown in Figure 1 were taken. At least five open safety pins and what at first was described as a small staple were noted in the stomach. In the region of the left lower lobe of the lung two needle-like objects were seen, and uncounted others were distributed along the intestinal tract.

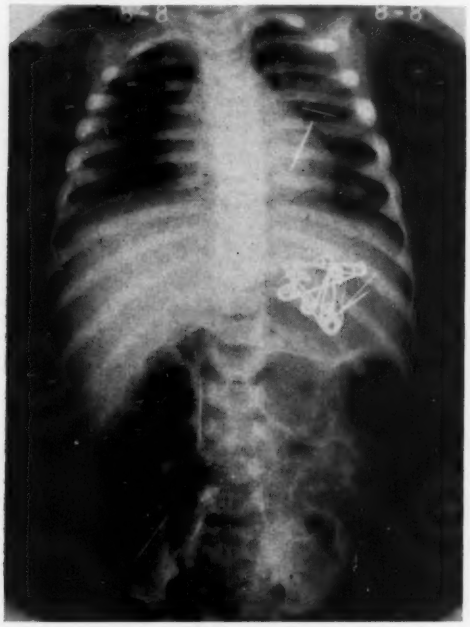

Figure 1.

The child was seen in consultation and transferred to the ear, nose, and throat department. Here endoscopy was performed; however, no foreign bodies were located. Lateral x-ray views taken at this time suggested that the thoracic needles already had penetrated anteriorly (Fig. 2).

During the following days the infant remained dyspneic and listless and had a dry hacking cough. The lung findings changed very little. His temperature ranged between 102 and 104.2 F (rectally) despite antibiotic therapy. Small transfusions of whole blood were given, following which some improvement in nutrition and hydration occurred. His abdomen, though distended, remained soft; peristalsis was never exaggerated. Small oral feedings were retained by the fourth day. During this first week two steel phonograph needles were recovered in the stool; x-rays indicated at least seven more needles distributed along the gastrointestinal tract. The safety pins all remained above the pylorus. At the end of this first week a needle-like object was discovered by palpation in the left third interspace of the anterior thoracic wall, in the midclavicular line. Lateral x-ray views suggested a second needle in the posterior chest wall.

In the succeeding week blood cultures, throat smears, and stool cultures revealed no pathogens. A further drop in hemoglobin required additional transfusions. On one count an ominous sharp rise of the polymorphonuclear cell count to 91% seemed to reflect a possible perforation of a viscus, but the abdomen continued to remain soft, with peristalsis remaining normal.

By the 12th day of hospitalization the child's temperature had dropped by lysis to 99 F (rectally). His lungs were now clear to percussion and auscultation. One open safety pin, 4 cm. long, was recovered in the stool. The following day the temperature again rose in a low spiking curve. Careful examination disclosed a small slightly reddened indurated area with a firm center 2 cm. above and 1 cm. to the right of the umbilicus. Lateral x-ray views proved this to be a penetrating needle (Fig. 3). The next day, in surgery, this needle and the one palpable in the anterior chest wall were removed via simple skin incisions under local anesthesia. The surgical report describes the foreign bodies as needles of rusty metal, without eyes, 2.7 cm. and 2.4 cm., respectively, in length. The child's temperature was normal the following morning and remained so.

During the next few days, however, the infant again became fussy. Thorough repeated examinations revealed no complications of an otherwise uneventful recovery. One morning an almost completely collapsed toy balloon was found protruding from the rectum and was gently extracted. It was then brought to our attention that a toy balloon, given as a gift by one of the Gray Ladies, had been unaccounted for. After this balloon extraction the little boy regained his usual placid composure and remained happy.

By a month after admission the child had gained weight remarkably well. X-rays now showed only one safety pin in the stomach. Some "broken bits of needles" were still seen along the gastroin-

Figure 2.

testinal tract; the needle in the posterior chest wall remained unchanged in position. At this time the child contracted chicken pox and was placed once again in the contagious section.

No change in the remaining foreign bodies were noted during the following months. Six months after admission an unsuccessful attempt was made to remove the remaining open safety pin via a gastroscope under biplate fluoroscopy (Fig. 4). An exploratory laparotomy then was recommended. At surgery the open safety pin, 4 cm. in length, was found in the lowest and deepest portion of the second part of the duodenum. There was no evidence that it had perforated the intestinal wall. In the lesser curvature of the stomach, posteriorly, the operator, with a finger in the gastrostomy opening, felt vaguely what was thought to be a piece of needle seen by x-ray. It was inaccessible through this opening, and since it could not be visualized it was left undisturbed.

Seven months after admission the child had grown to be a healthy robust person, more than double his admission weight. He had yielded at least 5 open safety pins, 1 balloon, and 10 phonograph needles, including those recovered by surgery. Two more needles remained, one in the posterior chest wall and one in the small bowel. It was decided to discharge him to the clinic for follow-up.

COMMENT

Such multiple perforations of the alimentary or respiratory tracts are not uncommon.

Figure 3.

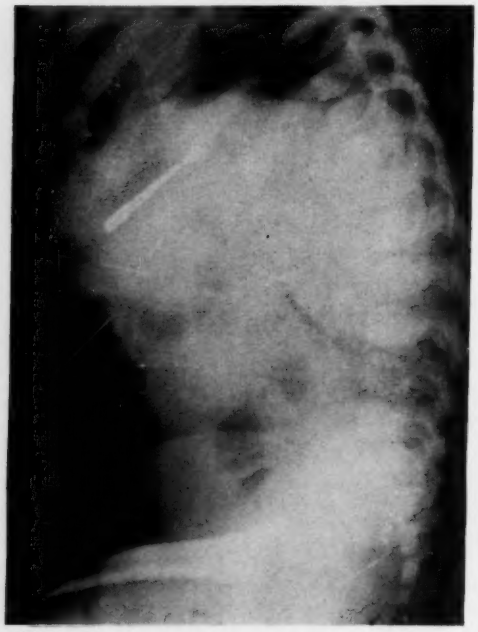

Figure 4.

However, perforation without serious sequellae, especially in such an infant, has seldom been reported. There is a large amount of data to support such judicious procrastination in delving for metallic foreign bodies. Most surprising, as in this case, are the size and character of foreign bodies that will pass safely. Except for foreign bodies in the trachea or larynx, today, with our armamentarium of antibiotics, metallic foreign bodies in the respiratory or alimentary tracts need not demand emergency extraction.

SUMMARY

A case is presented of a child of one year with 5 open safety pins in the stomach and at least 12 needles variously distributed in the respiratory and alimentary tracts. The subsequent history of these foreign bodies is given.

727 West 7th St.

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NEUROGENOUS TUMORS IN THE NECK

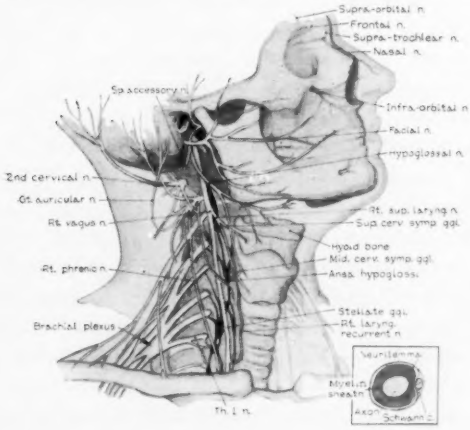
JOHN J. CONLEY, M.D., New York

NO GROUP of tumors in the neck is so rare, so curious, and so little understood as those of neurogenous origin. The cells which compose these tumors are derived from the neural crust and are classified as neurectodermal in origin. The neurectodermal neoplasms are identified by a characteristic benign or malignant arrangement. The cells associated with the individual type of tumor are the Schwann cells, the ganglionic cells, and the paraganglionic cells.

The Schwann cell is a most interesting and versatile cell and the one responsible for the majority of the tumors of neurogenous origin in the neck. It forms the sheath around the nerve fibers and possesses an extensive regenerative potential, even to the point of producing fibrous tissue. Its benign neoplastic growth can occur in any nerve fiber possessing a neurilemma. This includes the cranial nerves and sympathetic systems in the neck. Its malignant growth, the malignant schwannoma, generates from the neurilemma and destroys the nerve. In the past, it has been frequently and erroneously classified as a neurogenic sarcoma or neurofibrosarcoma. It is frequently associated with disseminated von Recklinghausen's disease, or may rarely appear as a solitary tumor (Fig. 1).

From the Head and Neck Service, Pack Medical Group, and the Surgical Service, St. Vincent's Hospital.

Fig. 1.—Nerve elements of neck showing various potentials for the development of tumors.



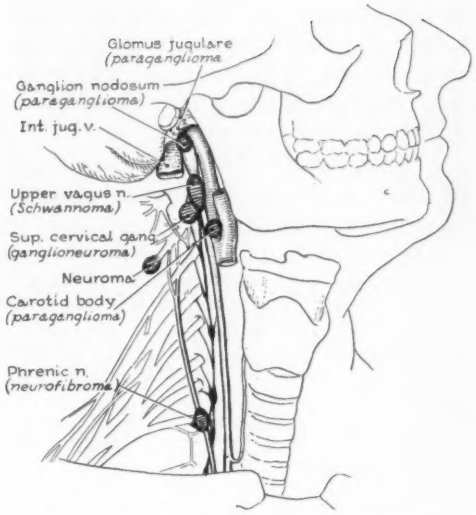


Fig. 2.—Tumors of neurogenous origin occurring in the neck and the relative positions most commonly encountered.

The ganglionic cells of the sympathetic nervous system in the neck present varying degrees of differentiation from the mature benign cell of the ganglioneuroma through the partially differentiated ganglioneuroma to the malignant neuroblastoma (sympathicoblastoma). The cellular structure is specific, but there is often variation in degree of differentiation.

The paraganglionic cells of the sympathetic and parasympathetic systems are curious structures sparsely and widely scattered throughout the neck. Their neoplastic potential is slight, but the tumors they produce are extremely interesting. The tumor is identified without difficulty as a paraganglioneuroma,

benign or malignant, and situated in the carotid body, the ganglion nodosum, the glomus jugulare, and the ganglia of the sheath of the glossopharyngeal nerve. All the paraganglioneuromas of the neck are hormonally inactive, as contrasted with their hormonally active counterpart, the pheochromocytomas of the medulla of the adrenal and, occasionally, retroperitoneal and mediastinal pheochromocytomas.

A classification * of these tumors and six illustrative cases are reported to assist in management of the tumors (Fig. 2).

Tumors of Neurogenous Origin in the Neck

Origin	Benign	Malignant
Neurectodermal	.....	.....
Nerve tissue (non-neoplastic)	Neuroma 1. Amputation 2. Traumatic	.....
Supportive tissue Neurilemma (neoplastic)	Neurilemoma, encapsulated (Schwannoma)	Malignant schwannoma
Nerve and neurilemma (neoplastic)	1. Neurofibroma 2. Multiple neurofibromatosis (von Recklinghausen's disease)	Malignant schwannoma
Ganglionic cells (neoplastic)	Ganglioneuroma 1. Differentiated	1. Sympathicoblastoma (neuroblastoma) 2. Partly differentiated
Paraganglionic cells (sympathetic and parasympathetic) (neoplastic)	Paraganglioneuroma 1. Carotid body 2. Ganglion nodosum 3. Glomus jugulare 4. Ganglia of sheath of ninth nerve	Malignant paraganglioma

NEUROMAS

Neuromas of the nerves of the neck occur after amputation of the nerve element or trauma to a nerve. The phenomenon is rare from the clinical point of view, when one considers that in a radical neck dissection all the sensory nerves associated with the cervical plexus are resected in a routine manner. Occasionally, the local pathological situation demands the resection of the vagus, hypoglossal, spinal accessory, and sympathetic nerve elements. Nature's efforts to reconstitute the nerve pathway by regeneration of the Schwann cells and mesodermal elements in the cervical nerves are completely frustrated because of the total absence of any distal nerve elements with which to form union and continuity. This non-neoplastic proliferation of neurectoderm forms a fusiform type of bulbous enlargement of the proximal nerve segments into which new axis cylinders grow. They become entangled in the proliferated Schwann cells and mesodermal elements and scar tissue. If the regenerative process is not overly active and the scar tissue not hypertrophic in character, the perception of pain or discomfort in the area of this transected nerve never reaches the clinical level. However, if the proliferative procedure is hyperactive and the scar tissue excessive, the patient will complain of localized pain and tenderness. It rarely reaches excruciating proportions. There is a responsibility in differentiating the occurrence of this new mass from the original disease which necessitated the radical neck dissection. This is done by careful history taking and aspiration biopsy.

The treatment of amputation neuroma of the neck is never urgent in character, and, indeed, temporization may lead to spontaneous improvement. This is particularly true if the neuroma appears within the first year of surgery and is associated with excessive scar formation in the wound. After an interval of a year, a considerable amount of the scar tissue disappears spontaneously, and this is often associated with marked relief of the discomfort in the neck. If, however, the symptoms persist into the second year and a localized and painful and tender mass is present in the region of the stumps of the cervical nerve elements, the neuroma should be excised.

NEURILEMOMA (SCHWANNOMA)

The neurilemoma, or schwannoma, is a benign tumor arising from the cells of Schwann of the neurilemma covering the nerve. It may occur in any nerve possessing a neurilemma. This would include the cranial nerves which enter and pass through the neck, the nerves of the cervical and brachial plexus in the neck, and the sympathetic nerves of the neck. Although its potential

* Modified after Stout.[13]

for occurrence is great, its actual clinical occurrence is rare. About 25% of the neurilemomas reported have occurred in the head and neck. The remainder have occurred in the mediastinum, chest and abdominal cavities, and the extremities. Schwannomas of the fifth, seventh, eighth, and tenth cranial nerves, phrenic nerve, cervical and brachial plexuses, and cervical sympathetic nerves have been described.

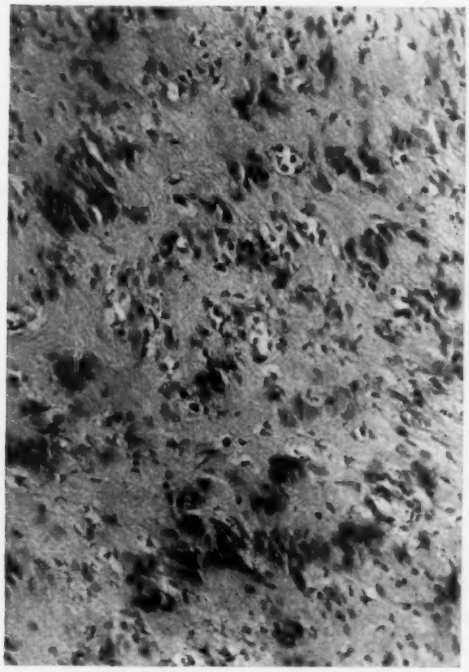


Fig. 3.—A case of neurilemma with palisading of the nuclei. Separation of the nuclei by Verocay bodies is evident. Reduced ⅓ from × 150.

No causative factors are known. The tumors may develop at any period during life and are equally divided among the sexes.

The tumor enlarges slowly, attaining a size from 1 to 7 cm. over a period of years. The tumor usually causes no symptoms. Pain is absent, and the patient merely relates his awareness of the tumor mass. If the tumor mass becomes unusually large and is situated in a vital functioning area or in a vital position in the nerve trunk, it may cause interference with breathing, swallowing, talking, moving the head, and may be associated with pain, and paresthesia.

The course is benign throughout, and malignant change has not been reported. An attempt at differential diagnosis from all other tumor masses of the neck should be made preoperatively by aspiration biopsy.

The microscopic picture of neurilemoma is characteristic (Fig. 3). Inside the sheath and capsule are two types of tumor tissue, identified as Antoni Type A and Antoni Type B. They intermingle but are sharply defined. The long bands of Schwann cells, the delicate connective tissue fibers, and the tendency toward palisading of the nuclei with these cells, assuming an organoid appearance at times (Verocay body), identify the Antoni Type A tissue. The Type B tissue is loosely arranged and is complex and consists of delicate reticulum fibers and microcysts. Ordinarily, the neurilemoma does not contain neurites.

Treatment is always total surgical removal. The tumors are encapsulated and do not metastasize. They are not sensitive to radiation. During the operation, every effort should be made to conserve the continuity of the neural pathway, as the tumor is essentially an encapsulated benign tumor of the neural sheath. A normal noninvolved segment of the nerve should be identified on each side of the neurilemoma and traced to the tumor. The nerve may have been pushed to one side by the development of the tumor, or it may have become spread out as a result of the growth of the tumor and its capsule between the different nerve fasciculi.

In the vast majority of instances, care and the isolation of the nerve while the tumor is being removed will preserve the continuity of the neural bundle. If it is technically impossible to preserve the nerve bundle intact and the tumor is less than 2 cm. in length, it may be possible to do a direct end-to-end approximation of the cut nerve ends after appropriate mobilization of the proximal and distal nerve segments, and angulation of the head and neck to relieve tension on the suture lines. If it is necessary to excise more than 2 cm. of the nerve and this pathway has vital

clinical significance, one should consider the immediate implantation of a free nerve graft.

NEUROFIBROMA (MULTIPLE NEUROFIBROMATOSIS)

In neurofibroma, there is an extensive proliferation of the peripheral nerve elements. 1. This phenomenon may occur in a single nerve as a localized tumor. 2. It is, however, usually associated with multiple neurofibromatosis or von Recklinghausen's disease. A developmental and physiological activity of the entire peripheral nervous system is involved, and the clinical syndrome is usually a diffuse and generalized one, rather than a localized phenomenon. There is marked proliferation of Schwann cells and nerve fibers. This may occur at the end of a nerve, producing non-encapsulated nodular café-au-lait pigmented growths in the skin. This phenomenon may coalesce into a thickened, pigmented, elephantiac-type skin. The nerve sheaths are frequently so hypertrophied that they become plexiform in character. This plexiform neurofibroma may extend up the nerve sheath and enter the spinal canal. Neurofibroma limited to the neck is a very rare condition. Generalized von Recklinghausen's disease usually manifests itself early in life and may abate spontaneously after puberty. On the other hand, the tumor may continue to grow toward the spinal canal or develop into a malignant neurilemoma.

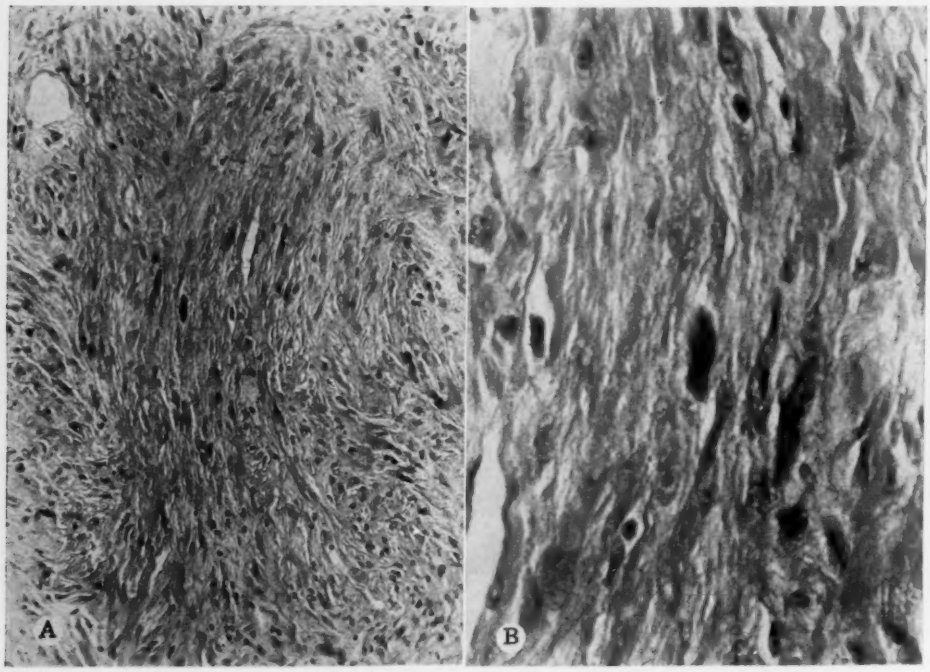


Fig. 4.—*A*, a nonencapsulated infiltrating and recurring neurilemoma of rather low grade but definite malignancy. There is fasciculation of the fibers and some palisading of the nuclei. The variations in size, the chromatin arrangement of the nuclei, etc., are indicative of the malignant character. Reduced ⅓ from × 150. *B*, greater magnification of a field of *A*, showing the fasciculation and nuclear changes; reduced ⅛ from × 450.

MALIGNANT NEURILEMOMA (MALIGNANT SCHWANNOMA)

This malignant nerve tumor arises from the Schwannian cells of the neurilemma. It may occur in any age group, but is commonest after the fifth decade of life. It has no connection with benign neurilemoma, as there are no recorded instances of a benign neurilemoma turning into a malignant neuri-

lemoma. However, it has a definite and specific association with multiple neurofibromatosis (von Recklinghausen's disease). It is estimated that about half of the malignant neurilemomas arise in persons with disseminated neurofibromatosis. The disease carries a very poor prognosis, as it not only diffusely and widely infiltrates the surrounding tissues but metastasizes readily through the blood stream to the chest, bone, liver, and brain. Lymphatic invasion is uncommon.

It may ulcerate through the skin, forming a semifixed, ulcerating tumor mass. Or, it may form a fusiform dilatation of a nerve trunk. It destroys the nerve inside the sheath. It is not limited by a capsule, and there is insidious and persistent infiltration to the surrounding tissues. Microscopically, the Schwann cells tend to grow in cords and palisade, separated by delicate reticulum fibers (Fig. 4 *A* and *B*).

GANGLIONEUROMA

A differentiated or mature ganglioneuroma is a benign tumor made up of sympathetic ganglion cells and sheathed nerve cells. Any of the cervical sympathetic ganglia of the neck may be involved by this tumorous growth. It is found predominantly in children in adolescence, with a slight preponderance in females. It is uncommon. These tumors contain differentiated ganglion cells and neurites. The tumor is encapsulated; it does not infiltrate and does not metastasize. It may attain a large size, however, and, as the result of pressure grow through one of the intervertebral foramen and continue to expand in the spinal canal.

When these tumors originate in one of the cervical sympathetic ganglia of the neck, a Horner's syndrome is usually present. The patient has no specific symptomatology when the tumor is small, other than the awareness of the presence of this tumorous mass. As the tumor increases in size, pressure phenomenon affecting the local area and other associated nerves may manifest itself in progressive difficulty in speaking, breathing, swallowing, or moving the head. The size of the tumors may be of such magnitude as to cause asphyxiation and starvation, and if they have entered the spinal canal, paraplegia may develop.

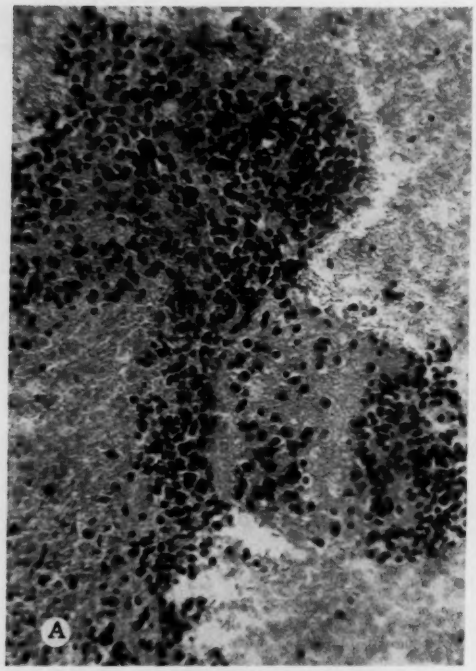
The treatment of this condition is complete surgical removal. The tumors are insensitive to radiation. The surgical extirpation of this tumor means resection of a portion of the sympathetic chain. If the tumor is small, the other associated nerves in the locality of the tumor may not be entrapped by its growth, and will, therefore, not necessarily have to be resected. If, however, the tumor has encapsulated and enmeshed these nerves, it may be necessary to resect them along with the tumor mass. The nerves which are most frequently involved are the vagus, spinal accessory, hypoglossal, and cervical plexus. If it is necessary to sacrifice these additional associated nerves, then end-to-end approximation and free nerve graft should be carried out during the operation. The prognosis is excellent.

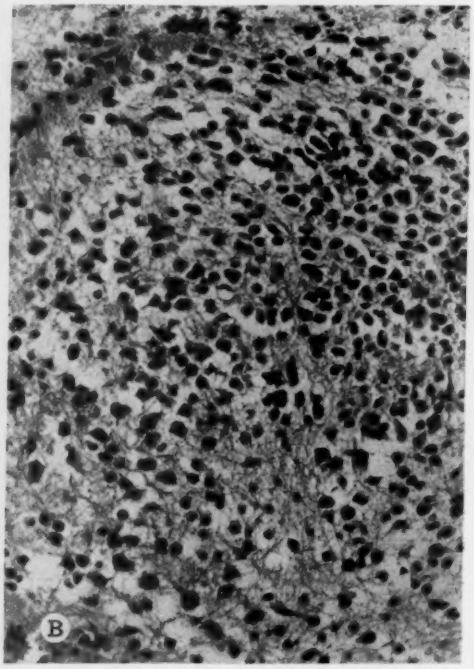
SYMPATHICOBLASTOMA (NEUROBLASTOMA)

Malignant tumors derived from sympathetic ganglion cells are divided into the partially differentiated ganglioneuromas and the sympathicoblastomas. Twenty-five per cent of the ganglioneuromas manifest varieties of undifferentiated sympathicoblasts. The behavior of these tumors is quite similar to that of the benign ganglioneuroma in all respects, except that the partly differentiated ganglioneuromas show a marked tendency to metastasize.

The treatment of the partially differentiated neuroblastoma is wide surgical extirpation. In these instances, the surgical procedure is more aggressive, with major emphasis on complete extirpation. The prognosis is fair.

The highly malignant sympathicoblastoma is made up of embryonal sympathicoblasts. It is a very rare tumor in the neck, and when it occurs in the sympathetic cervical ganglion it grows rapidly, infiltrates all the surrounding tissues, increases in size at the destructive expense of its neighbors, and metastasizes freely by all routes, particularly through the





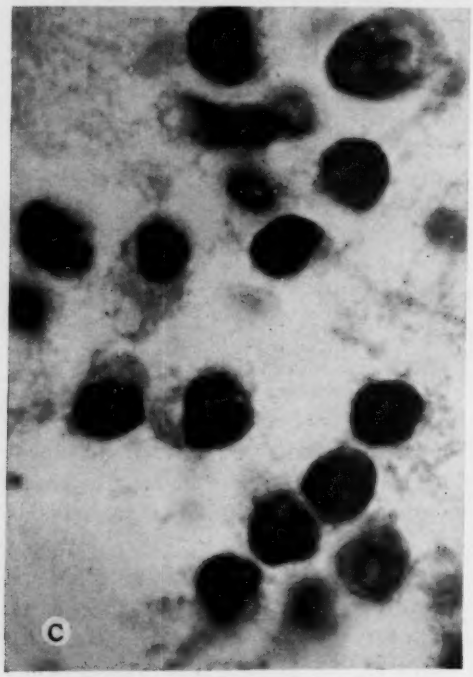


Fig. 5.—*A*, a case of sympathicoblastoma demonstrating poorly differentiated ganglionic cells; reduced ⅓ from × 150; *B*, reduced ⅓ from × 350; *C*, reduced ⅛ from × 750.

blood stream. The tumor has a marked tendency to become necrotic (Fig. 5 *A*, *B*, and *C*).

The treatment is wide surgical extirpation, when this is possible. In the neck, the tumor frequently attaches itself to and destroys vital structures, prohibiting its total extirpation. These structures include the bodies of the vertebrae and brachial plexus. They are insensitive to radiation and have a marked tendency to recur locally and at distant metastatic areas. The prognosis is poor.

PARAGANGLIONIC CELLS

Paraganglionic cells are derivatives of primitive nervous-system cells which migrate to the dorsal surfaces of the ganglion of either the sympathetic or parasympathetic systems, causing small, localized masses. In the neck, the paraganglionic cells are located in the ganglia of the sympathetic system. In the parasympathetic system, they are found in the carotid body, ganglion nodosum of the vagus nerve, glomus jugulare, and in the ganglia in the sheath of the glossopharyngeal nerve. All of these sympathetic and parasympathetic paraganglionic cells in the neck

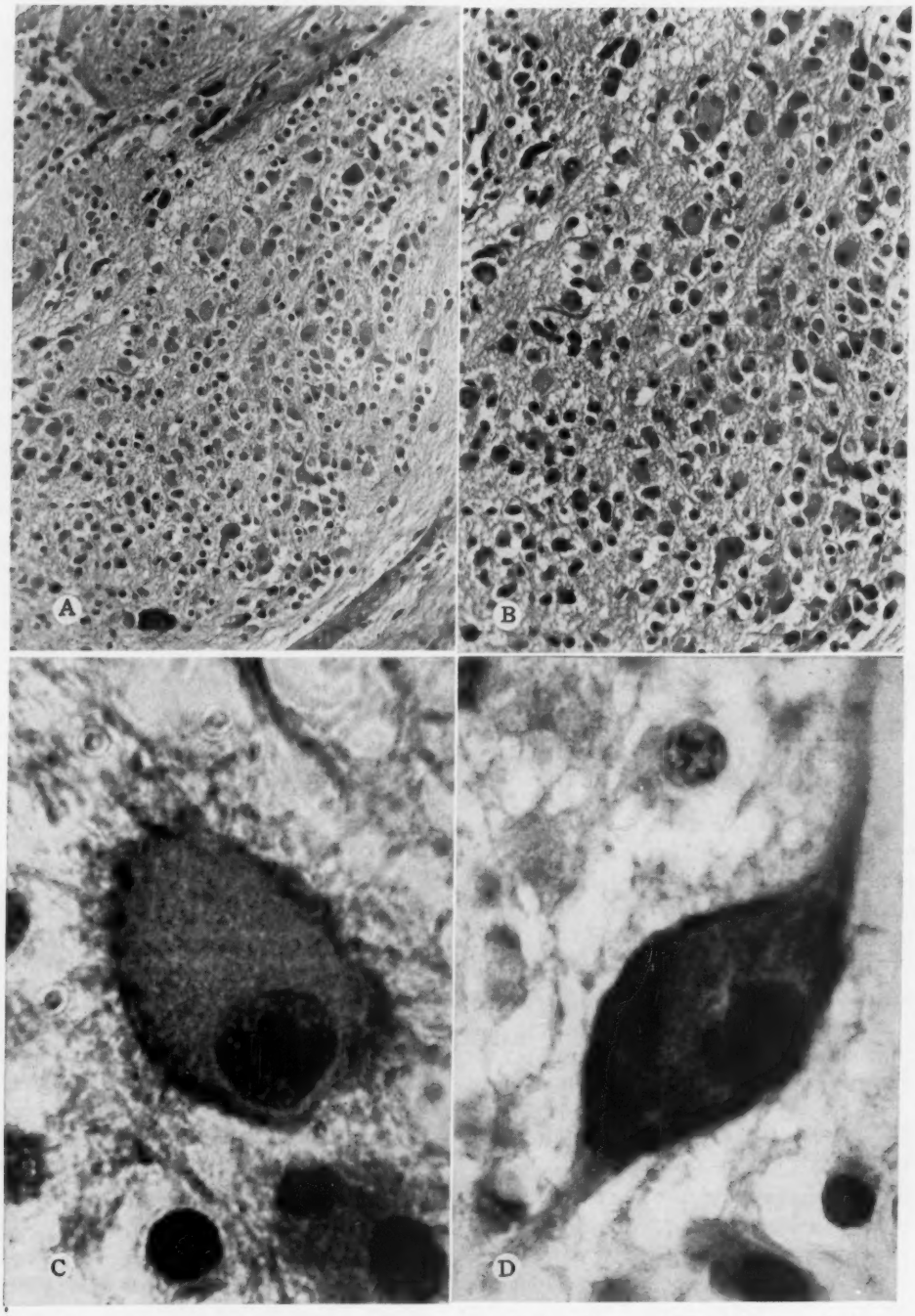


Fig. 6.—*A*, a case of paraganglioneuroma demonstrating the more differentiated portions; reduced ⅓ from × 150; *B*, reduced ⅓ from × 350; *C*, reduced ⅓ from × 750; *D*, reduced ⅓ from × 750.

are hormonally inert. These are contrasted with the paraganglionic cells of the sympathetic system contained in the adrenal medulla, which are hormonally active. The latter are called pheochromocytomas. These paraganglionic cells have a similar origin with the cells in the ganglia of the cranial nerves. Their singular differentiation is the hormonal activity.

The symptoms of the paraganglionic tumors associated with the carotid body, the glomus jugulare, the ganglion nodosum, and the glossopharyngeal nerve are not striking in the early phases of the development of the tumor, because these sites have no particular functional activity. The tumors grow very slowly and are painless. The patient is aware of the presence of a physical mass in his neck, which causes him no difficulty. However, as the tumor becomes larger, definite clinical symptoms appear. The carotid-body tumor can compress the carotid arteries, causing discomfort and syncope. It can compress and invade the vagus, hypoglossal, spinal accessory, and sympathetic nerve pathways in this area, with the resultant symptomatology. It can eventually bulge into the pharynx, causing difficulty in breathing and swallowing.

The microscopic appearance of paraganglioma is typical. The cells are large in size with misshapen nuclei arranged in small groups, enmeshed with a rich network of blood vessels and slender connective tissue fibers (Fig. 6 *A, B, C,* and *D*).

The treatment of carotid-body tumor in the past has been fraught with danger associated with the necessary occlusion of the common and internal carotid arteries for the excision of this tumor. A prohibitive operative mortality of 40 to 50% caused the leading surgeons in this field to adopt a "noli me tangere" attitude. With the establishment of sound vascular surgical principles, this attitude should no longer prevail, as it is now technically possible to perform a wide excision of the carotid-body tumor, including the common and internal carotid arteries, and to repair this defect by the immediate anastomosis of the free autogenous vein graft to the cut segments of the common and internal carotid arteries. Every effort should be made to maintain the continuity of the carotid arteries, vagus, hypoglossal, and spinal accessory nerves in this area. At times, however, they are so intimately enmeshed with the tumor that their salvage is unwarranted. Under these circumstances, end-to-end approximation or free nerve and vascular grafting should be carried out at the same operation. A small percentage of carotid-body tumors are classified as malignant paraganglioneuromas, which are locally invasive and destructive, involving the local musculature, vertebral bodies, and even the base of the skull. The prognosis in the malignant type is poor, although the prognosis for complete cure in the benign carotid-body tumor under the therapy outlined is excellent.

When the glomus-jugulare tumor has increased in size sufficiently to cause symptoms, the patient usually complains of progressive deafness, pain in the ear, tinnitus, and, later, facial paralysis and severe vertigo. When examined in the later stages of this tumor, the drum is perforated and presents a readily bleeding polypoid reddish mass, not associated with a primary or secondary infection ordinarily. Usually, the floor of the bony portion of the external auditory canal is destroyed, and a tumor mass exists in this area and extends down into the neck.

The treatment of this tumor is wide surgical excision. This includes a radical mastoidectomy and resection of the soft tissues inferior to the ear canal. The mandibular joint may be involved along with the parotid gland and facial nerve. Ligation of the sigmoid sinus and internal jugular vein facilitates the operation by reducing the hemorrhage that might be encountered. If it is necessary to sacrifice the facial nerve, an immediate nerve graft should be considered. Prognosis in cases of glomus-jugulare tumor is good.

Symptoms referable to a large paraganglioma of the ganglion nodosum of the vagus nerve are similar to those for carotid-body tumor. There is the additional danger of pressure erosion to the base of the skull in the region of the foramen lacerum as the tumor expands.

Treatment is complete surgical extirpation. The tumors are resistant to irradiation. Benign paragangliomas of the ganglion nodosum are unique in that they may be completely resected in some instances without permanent injury to the vagus nerve and the other important cranial nerves in this area, including the spinal accessory, hypoglossal, facial, and sympathetic ganglia. Their prognosis for complete cure is excellent.

Paraganglioma occurring in the ganglion in the sheath of the glossopharyngeal nerve and perforating branches in the middle ear (glomus tympanicus) may present no early symptomatology. As the tumor enlarges, however, pressure on the ninth nerve and associated structures causes pain and discomfiture in the throat and neck. Glomus tympanicus may develop all the symptoms of middle-ear disease listed under glomus jugulare.

Treatment is wide surgical extirpation. This may include a radical mastoidectomy and excision of the surrounding soft tissues in the neck. If the facial nerve is sacrificed, consideration should be given to nerve grafting. The prognosis is good.

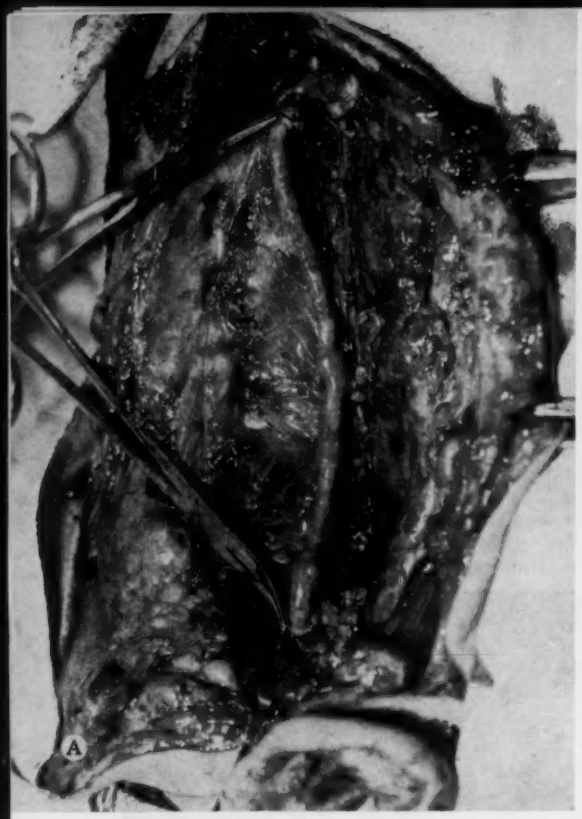
Six cases, including neuroma, schwannoma, neurofibroma, sympathicoblastoma, ganglioneuroma, and paraganglioma, are presented to illustrate certain points.

REPORT OF CASES

Ganglioneuroma.—An 8-year-old girl (J. T.) presented a tumor in the upper left neck at the age of 2 years. When she was 3 years of age, an unsuccessful attempt was made to remove the tumor, and the microscopic diagnosis of sympathicoblastoma was made. When she was 3½ years, a second unsuccessful attempt was made to remove the tumor mass. In November and December of 1947, the patient was treated with radiation, and a total of 8,000 r was administered. In October, 1948, an additional 1,100 r was administered. The tumor had gradually increased in size since that time (Fig. 7*A* and *B*).

Fig. 7 (Case J. T.).—*A*, large ganglioneuroma of first cervical ganglion, with Horner's syndrome and obvious crowding of the pharynx and nasopharynx. *B*, patient one year after operation, completely rehabilitated.

Examination revealed an 8 by 12 cm. protruding mass involving the entire left upper neck. It extended from the tip of the mastoid down to the level of the cricoid cartilage and from the posterior margin of the sternocleidomastoid muscle around to the thyroid cartilage anteriorly. The skin over the



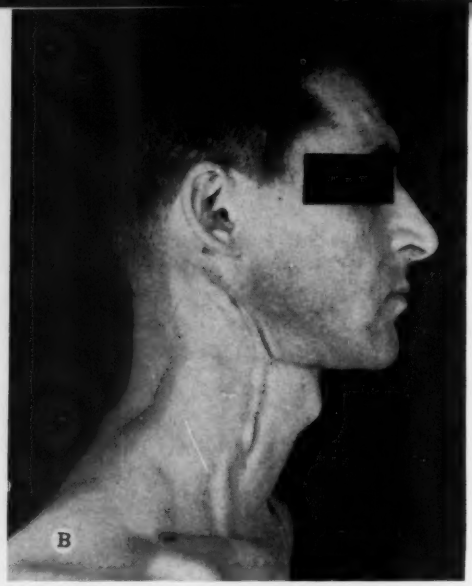


Fig. 8 (Case B. P.).—*A*, an autogenous vein graft is anastomosed to the common and internal carotid arteries after the resection of a large carotid-body tumor. *B*, patient two years after operation, completely rehabilitated, but with obvious outline of vein graft.

tumor showed marked evidence of x-ray fibrosis, pigmentation, and atrophy. Horner's syndrome was present on the left. The left side of the tongue was moderately atrophied. It contained obvious muscular fibrillations, which were constant. There was marked weakness of the hypoglossal nerve and slight weakness of the lower branches of the facial nerve. The mass compressed the inferior tip of the parotid gland and extended into the pharynx, nasal pharynx, hypopharynx, with a marked bulging of the lateral pharyngeal wall, palate, and nasal pharyngeal walls. It seriously interfered with breathing and swallowing. The mass was fixed to the deep structures of the neck. There was no trismus.

A review of the microscopic sections revealed ganglioneuroma, quite mature in appearance, but infiltrating lymphoid and fibrous tissue.

In May, 1952, this patient underwent a resection of the ganglioneuroma with a left radical neck dissection in continuity. This dissection also included the resection of the vagus, spinal accessory, and hypoglossal nerves, which were invaded by the tumor and could not be saved. A prophylactic low tracheostomy was performed. The postoperative course was characteristic in that this patient had difficulty in swallowing, speaking, breathing. There were regurgitation and aspiration. This complex of symptoms gradually abated. In the meantime, thorough aspirations and feedings by nasogastric tube controlled the situation. The patient was discharged from the hospital approximately one month from the date of her operation. She had been totally rehabilitated in respect to breathing and swallowing her food. She was mildly hoarse. Routine examinations since the operation have revealed gradual recovery of movement on the left side of the face. There is almost normal movement of the tongue and the left shoulder. The left vocal cord is paralyzed, and the child is mildly hoarse. Her wound has healed per primam, and the area shows no evidence of recurrence of the disease. Her prognosis for complete cure is excellent.

Paraganglioneuroma.—A 37-year-old patient (B. P.) was seen in January, 1947. He related that he first recognized a swelling in the right side of the neck in 1937. The mass had been completely asymptomatic until his first examination in 1947, when he stated that it had been increasing in size over the past year to a noticeable degree and that he had a "choking" sensation in the neck. This was most prominent during sleep and caused him to turn his head to the opposite direction to relieve this sensation. He stated that there was no pain or difficulty in swallowing.

Examination at that time revealed a 5 cm. mass situated in the region of the bifurcation of the carotid, possessing a deep attachment and moving with the pulsations of the carotid artery. The tumor was subtotally excised in January, 1947. The postoperative course was complicated by a paresis of the right hypoglossal and right recurrent laryngeal nerves.

In July, 1951, the tumor had recurred. It was lobulated, soft, and sensitive to touch. A radical resection of the carotid-body tumor, along with the associated scar tissue, the carotid bulb, internal and external carotid arteries, and vagus nerve, was carried out. This nerve was enmeshed in the tumor

and could not be saved. The carotid artery defect was immediately corrected by the transplantation of a suitable segment of the great saphenous vein from the leg, carefully anastomosed into position with interrupted fine nonabsorbable surgical (silk) sutures (Fig. 8*A* and *B*). A prophylactic low tracheostomy was performed. Heparin was not employed. The wound healed per primam. The patency of the anastomosed vein graft was evident throughout the postoperative course. This patient had the characteristic postoperative difficulties with swallowing and speaking. Regurgitation and aspiration, resulting from section of the vagus nerve, were protracted and troublesome. It was unsafe to remove his tracheostomy tube for an interval of three

Fig. 9 (Case C. C.).—Preoperative view of neuroblastoma of ganglion nodosum.

months postoperatively because of his aspiration of food into the lungs. The resection of the vagus nerve in this patient not only caused permanent paralysis of the vocal cord with moderate hoarseness but the attendant anesthesia of the pharynx unwittingly permitted the aspiration of food. This complication gradually disappeared, and the patient, who is examined at frequent intervals, is completely rehabilitated. There is an obviously patent, functioning vein graft connecting the carotid arteries, and his prognosis for complete cure is excellent.

Sympathicoblastoma.—A 10-month-old child (C. C.), included through the courtesy of Dr. G. T. Pack, presented a mass in the upper right side of the neck at the age of 6 months. The mass had gradually increased in size but did not interfere with breathing or swallowing. X-ray of the mass revealed a mottled type of calcium deposition, and a preoperative aspiration biopsy of the mass was interpreted as sympathicoblastoma. Irradiation did not affect the tumor (Fig. 9).

In December, 1952, Dr. George T. Pack radically removed the sympathicoblastoma from the right upper neck. It originated from the ganglion nodosum of the vagus nerve, and although the vagus, hypoglossal, spinal accessory, and facial nerves were injured during the operation, they gradually and completely returned to normal.

The postoperative course was characteristically complicated by tracheal aspiration, regurgitation and hoarseness associated with pneumonitis, high fever, and toxicity. It was necessary to perform a gastrostomy to circumvent the complication. However, after an interval of four months, it was possible to decannulate the tracheostomy tube and feed the baby by mouth. Recent examination revealed all cranial nerves to be intact. There is a slight tendency to aspirate water, due to pharyngeal anesthesia secondary to the resection of the ganglion nodosum. The preservation of all other important cranial nerves in this area warrants special notation. The prognosis in this case is guarded.

Neurofibroma.—A 40-year-old patient (K. M.) complained of a shooting type of pain down her right arm upon twisting her head to the left side. She also related that when her husband put his arm around her neck, pain would shoot down her right arm. In February, 1950, she became aware of a small, sensitive mass in the region of the right cervical portion of the brachial plexus, that caused pain down the arm upon manipulation.

Examination revealed a 1 by 2 cm. mass, just above the right clavicle in the cervical portion of the right brachial plexus. It was fixed to the deep colic fascia, and manipulation of it caused shooting pains down the arm. It did not pulsate. Neurological and muscular evaluation of the arm did not reveal anything unusual. There was no evidence of diffuse, multiple nodularity or von Recklinghausen's disease.

At the operation in May, 1950, a discrete neurofibroma was discovered in the cervical portion of the brachial plexus. It involved the plexus of the junction of the fifth and sixth cervical nerves. It was removed with a minimum of trauma, permitting the main nerve pathways to remain intact. The postoperative course was complicated by weakness in raising the arm over the head. After an interval of four months, motor power had returned to the arm, and the patient was completely rehabilitated. The prognosis for complete cure in this instance is excellent.

Neuroma.—A 55-year-old patient (O. G.) had undergone radical resection of the left neck, mandible, and a segment of the tongue for primary

squamous-cell carcinoma of the tongue, which had metastasized to the left neck in 1948. He complained of gradually increasing pain in the upper left side of the neck. Routine postoperative examinations over a period of three years revealed a gradually enlarging, distinctly painful and tender mass in the region of the amputated root of the cervical plexus on the left side. The mass measured about 1.5 cm. in diameter.

Operation in June, 1951, revealed a neuroma growing on the cut segment of the fourth cervical nerve, just lateral to and slightly below the bifurcation of the common carotid artery. It measured approximately 1.5 cm. in length and was surrounded by a barrier of scar tissue. It was amputated flush with the branch from the root of the fourth cervical nerve that goes along with a branch from the fifth cervical nerve to comprise the phrenic nerve. The postoperative course was completely uneventful. The prognosis for complete cure is excellent.

Schwannoma.—An 11-year-old girl (G. R.) complained of a gradually enlarging mass in the right upper neck, over a period of two years. In the beginning, it was completely asymptomatic, but for the past six months her speech had become nasal in quality and eating her food had become awkward. There was no pain (Fig. 10*A* and *B*).

Examination revealed a 6 by 8 cm. solid, semifixed mass in the upper part of the right neck. It bulged into the nasal pharynx and palate and oropharynx. There was a well-healed 3 cm. scar directly over the mass where a previous biopsy specimen had been taken. The biopsy diagnosis was schwannoma (neurilemoma). There was no paralysis of any of the cranial nerves on the involved side, and a Horner's syndrome was absent.

In March, 1953, a resection of this tumor was carried out. It was well encapsulated and not infiltrative. It arose from the neurilemma of the superior portion of the vagus nerve in the neck and filled the space from the level of the hyoid bone to the base of the skull. A radical neck dissection was not performed with the excision of the mass, because the tumor had been classified preoperatively as benign. The hypoglossal and spinal accessory nerves were enmeshed in the tumor, along with the vagus nerve, and were excised. It was possible, however, to perform a direct approximation of the cut ends of the hypoglossal nerve after the tumor had been resected. A low prophylactic tracheostomy was performed.

Fig. 10 (Case G. R.).—*A*, schwannoma arising from neurilemma of vagus nerve. *B*, schwannoma bulging into nasopharynx.

The postoperative course presented a paralysis of the right side of the tongue and drop of the right shoulder. A Horner's syndrome was not present. The most troublesome phase of the postoperative course was associated with the symptoms related to resection of the vagus nerve at this high level in the neck. The anesthesia of the pharynx and larynx and paralysis of the right vocal cord were characteristically complicated by regurgitation of food with aspiration. These troublesome phenomena gradually abated after a period of approximately six weeks.

During this time, it was necessary to maintain nourishment through a nasogastric tube and carry out active tracheal suction. Recent examination revealed the patient to be completely rehabilitated. The tongue protrudes in the midline. There is a well-compensated minimal hoarseness, and she eats without difficulty. The prognosis in this particular instance is excellent for complete cure.

SUMMARY AND CONCLUSIONS

Tumors of neurogenous origin occurring in the neck are derived from neurectodermal cells of the neurilemma, ganglionic cells of the sympathetic system, and paraganglionic cells of the sympathetic and parasympathetic systems. The majority of these tumors are benign and a small percentage of them malignant. They are asymptomatic in the early stages of development. However, as they increase in size, discomfort, pain, sense of pressure, difficulty in breathing, swallowing, and speaking, vertigo, tinnitis, draining ear, deafness, and other symptoms appear, depending upon the interference of function of the various vital neural pathways. There is, in fact, no specific clinical sign or symptom which will identify these tumors preoperatively. The differential diagnosis may be established from other tumor masses in the neck by a preoperative aspiration biopsy. This will frequently not only identify the types of neurogenous tissue present but the degree of differentiation. The operation should be planned on the basis of the preoperative biopsy diagnosis.

All the benign tumors of neurogenous origin are encapsulated and noninvasive in character. These tumors do not respond to radiation. They are successfully treated by total removal, which in most instances is not technically difficult.

In the surgical extirpation of these neural tumors, every effort should be made to preserve the continuity of the nerve pathway of the involved nerve and the associated nerves in that area. The structures which are most frequently involved are the vagus nerve, the sympathetic and parasympathetic nervous system, the ganglion nodosum, the hypoglossal, spinal accessory, glossopharyngeal, phrenic, cervical, and brachial plexus nerves. If one or more of these neural trunks is involved in the tumorous mass, an effort should be made to dissect it free. If this is impossible, one should consider direct approximation of the cut ends or a nerve graft if the nerve performs a vital function. The sympathetic chain is ordinarily cut with impunity, yet excision of the vagus nerve at this high level in the neck will cause dysphagia, regurgitation, esophageal, cardiac and pyloric spasm, and paralysis of the homolateral vocal cord and soft palate. Homolateral anesthesia of the pharynx and larynx also results. The symptom complex may be complicated by aspiration pneumonia, tachycardia, respiratory distress, etc. These complications are averted by a prophylactic tracheostomy and a nasogastric feeding tube, which may be necessary for a rehabilitative period extending from one to three months postoperatively.

The malignant tumors of neurogenous origin in the neck are usually nonencapsulated and locally invasive, destroying soft tissue by both invasion and pressure. The treatment of the malignant group is wide surgical extirpation. In the advanced cases, this is frequently technically impossible because of the invasion and destruction of vitally adjacent structures. The neuroblastoma metastasizes aggressively and has a very poor prognosis.

The prognosis for complete cure in the benign tumors of neurogenous origin in the neck is excellent. The neuroma, the schwannoma, the solitary neurofibroma, the ganglioneuroma, and the majority of paraganglioneuromas have an excellent prognosis. The anastomosis of a free autogenous vein graft to the common and internal carotid arteries in the treatment of carotid-body tumors has greatly improved the handling of this once difficult problem. An understanding of the nature of the benign neurogenous tumors in the neck and the utilization of reconstruction of neural pathways have added greatly to the management.

Six representative cases illustrating the various types of neurogenous tumors in the

neck are described to correlate the principles of treatment.

139 E. 36th St. (16).

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ADEQUATE SURGERY FOR EXTENSIVE CARCINOMA OF THE PHARYNX, LARYNX, AND CERVICAL ESOPHAGUS

The Problems Encountered

S. C. MISSAL, M.D., Cleveland

ONE OF the most distressing clinical problems encountered by the laryngologist is the patient afflicted with a far-advanced neoplasm of the pharynx, larynx, or cervical esophagus. If his end is not hastened by widespread metastasis, pulmonary complications, or massive hemorrhage from an eroded vessel wall, the patient ultimately undergoes two surgical procedures, viz., a tracheotomy to provide an airway and a gastrostomy to provide nutrition. In any event, if the course of the disease is not arrested, the patient faces a period of suffering and discomfort such as is seen in few other conditions.

Encouraged by the successes achieved in the surgical treatment of intrinsic carcinoma of the larynx and by the progress made in dealing with lesions of the lower esophagus, surgeons have been devoting their attention to the surgical treatment of tumors involving the pharynx, larynx, and cervical esophagus with extension to adjacent structures, particularly the lymph nodes of the neck. Added impetus has been given to their work by advances in other fields of medical science, notably anesthesia, the antibiotics, and fluid and electrolyte balance in the body.

In the past, most of these neoplasms had been considered inoperable and irradiation had been the principal therapy offered. Although results of radiologic treatment are improving somewhat with the newer techniques of administration, it is quite fair to say that the benefits achieved in pharyngeal, laryngeal, and upper esophageal carcinoma with this method of therapy leave much to be desired. For this reason some patients with these lesions are now being subjected to wide excision with accompanying radical neck dissections with the hope of achieving better results.

Critics of this newer surgical approach argue that the procedure is too radical, that the suffering and discomfort endured by the patient is too great a price to pay for the benefits received, since the odds against a complete cure are so great; and, finally, they cite the economic aspect of the problem by stating that the prolonged hospital stay is a financial burden beyond the means of most families and that the patient, should he survive, is frequently unable to resume his place in society or become gainfully employed.

The criticism that this type of surgery is too radical brings up the question: What constitutes the term radical when it is applied to the field of cancer? It should not be considered a radical procedure if the surgeon resorts to extensive resection of tissue to check the course of cancer. The terms conservative and radical surgery should be discarded when one thinks and speaks of cancer surgery. We propose that the terms adequate and inadequate surgery should be adopted. Adequate surgery consists of eradication of all tumor cells known to be present in the body. The only limitations imposed upon the surgeon should be insurmountable technical obstacles and compatibility with life. Inadequate surgery consists in knowingly leaving behind tumor tissue which technically offers no obstacle to excision and whose removal would not jeopardize the patient's life.

This definition of the terms adequate and inadequate surgery is predicated upon the existence of three factors. First, the surgeon

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must possess sufficient skill and knowledge to perform a thorough and adequate operation. Second, he must be disposed to execute the extensive surgery required. Cosmetic appearances should be no deterrent to adequate surgery. Third, he must exercise sound surgical judgment in the selection of patients suitable for the operation. Trotter,[1] in condemning operations on hopeless cases, aptly expressed himself when he said, "The performance of such operations is a mere virtuosity of surgical technique which exalts the manifestation of skill above its purpose."

The criticism that surgical treatment of these cases causes suffering and discomfort out of proportion to the benefits received is not valid. Even though a cure may not be attained, the palliation obtained by the patient makes the procedure worth while. This was the opinion of four unbiased laryngologists who shared in the study of six of the seven cases presented.

From the standpoint of nursing care and comfort of the patient, a tracheotomy created by excising the cancer-invaded larynx and attaching the tracheal stump to the neck tissues proved more satisfactory than an opening made into the trachea, leaving the invaded larynx in situ. In the latter case, the spilling-over of secretions and food particles causes a distressing cough and may eventually lead to aspiration pneumonia. Should the upper esophagus or pyriform sinus regions be involved, resulting in an inability to swallow food, a gastrostomy must be performed unless an operation to remove the primary growth is done. The latter procedure provides a suitable means for feeding the patient through an esophageal stoma in the cervical region. If regurgitation of food through the esophageal opening in the neck becomes a problem, a temporary gastrostomy, as advocated by Dunlop,[2] affords a means of supplying nutrition until such time as the pharynx and upper esophagus can be reconstructed. In the present series of cases no gastrostomies were performed.

Considering the criticism concerned with the economic aspect of the problem, one must concede that the prolonged hospital stay and extended period of morbidity do present a formidable economic obstacle to the patient and his family. In most areas, however, local social agencies are able to provide hospitalization at no cost to the patient. Furthermore, many of these cases could be cared for at home during periods of time between plastic procedures, were they not indigent, or were their families willing to care for them. From the standpoint of rehabilitation, the development of the esophageal voice has been a great aid to laryngectomized persons in their effort to resume their place in society.

Since the accumulated clinical experience with this type of surgery is not extensive in medical literature, the following series of seven cases operated on for advanced lesions of the pharynx, larynx, and cervical esophagus is reported. The final answers as to optimal surgical technique and justification for adequate surgery can not be forthcoming until these operations have been performed by a larger number of surgeons and upon a greater number of cases. A presentation of the problems encountered during the performance of the operations and the management of these patients may be helpful to others who may encounter similar pitfalls.

HISTORICAL REVIEW

Within the last two decades surgical treatment of advanced cancerous lesions of the hypopharynx and cervical esophagus aroused the interest of general surgeons and laryngologists to advance progress in this field of work. Recognition of the pioneer work that has been done by surgeons of the past generations on the esophagus has been presented in review by Slaughter and Roeser [3] and by Watson and Pool.[4]

Historically, carcinoma of the cervical esophagus was subjected to surgical treatment by Czerny [5] in 1877, when he removed an esophageal segment 6 cm. long and left the distal orifice open as an aid to feeding. The patient lived 15 months before death ensued from recurrent cancer. Von Mikulicz [6] in 1884 resected a cervical esophagus and performed a plastic skin repair. The pa-

tient survived 16 months after surgery before dying from recurrence. DeQuervain [7] in 1899 collected 14 records of similar operations, 1 of which he performed. There were five operative deaths. Von Hacker [8] in 1908 described an excision en bloc of the larynx and the esophagus. In 1934 Evans * reported a 23-year survival of a patient following surgical removal of a cervical esophageal cancer.

Slaughter and Roeser have classified the operations used for eradication of carcinoma of the cervical esophagus into four groups. The simplest approach is esophagotomy with local resection and primary storation of the pharyngeal and esophageal lumen.

The second procedure consists of surgical construction of an artificial esophagus by mobilizing parts of the alimentary tract. To counteract cicatricial stenosis resulting when using the antethoracic and plastic skin tube, advocated by von Mikulicz,[6] Eggers,† Turner, ‡ Torek, § and others, attempts have been made to bring various parts of the alimentary tract through a subcutaneous tunnel in the anterior thoracic wall. According to Slaughter and Roeser, the modification of Roux's principle, described by Yudin,[16] viz., of bringing the jejunum from the abdomen to the neck for direct esophageal anastomosis of mucosa to mucosa, has been satisfactory.

Local resection and primary repair with a cervical skin flap, advocated by Wookey, || Watson, ¶ and Brunschwig,[21] is the third surgical procedure noted. This technique, as advocated by Wookey, has been followed quite closely in three cases of this series. Slaughter and Roeser claim that this is the most practical procedure yet devised for this tumor site because it is accompanied by low mortality, lends itself to the radical resection frequently necessary, and establishes a primary reconstruction of the gullet.

Cervical gastroesophagostomy, the fourth type of procedure listed, is not, as a rule, performed by the laryngologist. This operative procedure is likely to fall within the province of the thoracic or general surgeon. Adams # and Phemister [24] pioneered in the development of this technique and described a procedure for cardioesophagectomy. Churchill,[25] Sweet,* and Garlock † performed progressively higher esophageal anastomoses following resection of the thoracic esophagus.

Wilfred Trotter,[1] in 1913, made an outstanding contribution to surgery of the pharynx for malignancy and to the development of skin-flap reconstruction operations. In 1920 [32] he gave a classic description of a method to attack lesions in the pharynx by lateral pharyngotomy. At a later date he made further contributions to surgery of th pharynx [33] and enumerated some principles pertaining to that type of surgery.[34] In 1932 [35] Trotter presented a list of eight cases of carcinoma of the hypopharynx free from recurrence for a period ranging from 3½ to 20 years after surgery. Colledge [36] contributed solutions to the problems of plastic reconstruction of pharyngeal defects after operations for removal of malignant tumors. He listed ‡ an impressive series of cases subjected to lateral pharyngotomy, 13 (33%) of whom were well 10 years later. Of 16 cases treated by pharyngolaryngectomy, 6 (37½%) were alive without recurrence 10 years after surgery was performed.

Laryngologists in this country were likewise interested in this problem. Tucker [38] believed that laryngectomy, subhyoidpharyngotomy, and lateral pharyngotomy would cure a good percentage of the intrinsic and extrinsic cases of laryngeal carcinoma. In 1930, Orton [39] published his results of operations on nine patients with epilaryngeal carcinoma using Trotter's technique. Two

* Evans, A., cited by Turner.[11]

† References 9 and 10.

‡ References 11 to 13.

§ References 14 and 15.

|| References 17 and 18.

¶ References 19 and 20.

References 22 and 23.

* References 26 to 28.

† References 29 to 31.

‡ Reference 37, cited by Dunlop.[2]

years later [40] he described his operation of anterior translingual pharyngotomy, which he performed on 15 cases. Orton [41] summed up the present-day concept of the problem when he defined radical surgery as a procedure sufficiently radical to remove the entire primary lesion, with proper attention given to the lymphatic drainage area. This type of surgical treatment planned must be governed by the type of malignancy, the extent of the growth, and the tumor site.

Negus § proposed an even more recent trend, namely, that cancer of the hypopharynx should be treated by pharyngolaryngectomy with primary repair. He suggested primary reconstruction of the pharynx by buried polyethylene (Polythene) tubing covered by a skin graft. Rob and Bateman [43] described a method of bridging gaps in the cervical esophagus with tantalum gauze covered by fascia lata. Klopp and his associates [44] worked out a method on dogs using the cervical portion of the esophagus in one stage. Baronofsky and Hilger [45] described a case in which a tube of tantalum mesh covered on the outside by fascia lata was inserted in the esophageal gap to obtain primary closure.

NECK DISSECTION

Since neck dissections were carried out in this series of operations, a brief historical sketch is in order. Hayes Martin and his associates [46] reviewed the subject excellently in an article published in 1951. These authors cited the work of the late George Crile [47] as the pioneer effort to develop neck dissection as a curative operation for cervical metastasis. Some authors before 1906 had made allusions to removal of the cervical lymph nodes, but none had developed it as a systematic procedure on a sound anatomic basis. In Crile's original work, he actually attempted complete removal of the cervical lymphatics. He recommended anesthesia by tracheal intubation, complete removal of the sternomastoid muscle, the internal jugular vein, and all of the areolar and lymphatic tissue of the various triangles of the neck. He advised temporary occlusion of the common, rather than the external, carotid artery for hemostasis, but warned that permanent ligation of the common or the internal carotid artery was dangerous.

It is of interest at this point to cite Trotter's [1] views on cervical lymph node involvement. He was guided by a rule which he stated as follows:

> We owe chiefly to Butlin the firmly based generalization that as soon as the primary disease is established the liability to gland infection has begun, with the practical corollary that the gland operation should be as much a part of the treatment as the removal of the primary growth.

Speaking of the varieties of cervical-node involvement, he goes on to say:

> The general rule for treatment should therefore be based on the knowledge that the primary growth and the possibility of gland infection appear practically together. A useful extension of the rule [quoted above] is the statement that the liability to gland infection bears no relation to the stage of the primary disease, that is to say, that for practical purposes there is no less liability to gland infection before the period of submucous invasion than there is after.

Ogura's [48] work bears out his statement.

Since the publication by Martin and associates is the authoritative last word on neck dissection, based on an experience of 1,450 operations performed at Memorial Hospital from 1928 to 1950, it is well to cite the indications for this procedure which they listed, and which were as follows: 1. There should be definite clinical evidence that cancer is present in the cervical lymphatics. 2. The primary lesion giving rise to the metastasis should have been controlled clinically; or, if not controlled, there should be a plan to remove the primary lesion at the same time that neck dissection is performed. 3. There should be a reasonable chance of complete removal of the cervical metastatic cancer. 4. There should be no clinical or roentgenographic evidence of distant metastasis. 5. Neck dissection should offer a more certain chance of cure than irradiation therapy.

§ Negus, V. E., in discussion on Owen.[42]

REPORT OF CASES

CASE 1.—A white man, aged 52, was first seen in the outpatient clinic on Nov. 10, 1947, complaining of persistent pain in his throat. Three months previously he had noted an annoying tickling, which gradually changed to pain. The pain became more severe, dysphagia set in, and he began to expectorate blood. A glazier by trade, he attributed his difficulty to inhaling ground glass.

Upon indirect laryngoscopy, a mass could be seen in the right hypopharynx. No cervical nodes were palpable. A roentgenogram of the chest was normal. Direct laryngoscopy revealed a mass extending upward from the esophagus and involving the right pyriform sinus, right aryepiglottic fold, and right side of the larynx. The biopsy specimen showed well-differentiated squamous-cell carcinoma.

Surgical treatment was advised, and the operation was performed on Dec. 1, 1947. The procedure consisted of a total laryngectomy, pharyngectomy, cervical esophagectomy, and a right radical neck dissection. The tracheal and esophageal stumps were sutured to the skin margins of the neck, and a skin flap from the right side of the neck was laid over the prevertebral muscles. A Levin tube was inserted into the esophageal stoma for feeding purposes.

Pathologic Diagnosis.—The pathologic diagnosis on the tissue removed at operation was well-differentiated squamous-cell carcinoma with metastasis to the regional lymph nodes.

Postoperative Course.—The patient's progress was satisfactory after the operation. Penicillin therapy, which was initiated prior to the operation, was continued. Three weeks after the operation the patient reported that he had swallowed the feeding tube. Roentgenographic studies were made daily to follow the course of the tube in the intestinal tract. The tube was passed spontaneously 10 days after it was swallowed.

The patient had four plastic procedures performed, to create a new cervical esophagus to bridge the gap between the pharyngeal and esophageal stomas. Figure 1 shows the appearance of the patient during the course of these procedures. Evidence of recurrence of the tumor in the right supraclavicular region led to the decision that further surgery was inadvisable. There was a steady deterioration of the patient's condition, and he died on Aug. 28, 1948, nine months after the original operation.

Comment.—This was the only case in the series with carcinoma of the cervical esophagus, and in which an attempt was made to close the opening between the pharynx and the esophagus by means of plastic procedures. The effort was fruitless because of recurrence of carcinoma.

In retrospect, it is fair to question whether a sufficient portion of the upper esophagus was removed. In view of the outcome in this case, it would appear that the resection of the esophagus should be as wide as possible.

The accidental swallowing of the feeding tube by this patient points up the necessity for close nursing supervision of patients with this type of operation. Although the incident

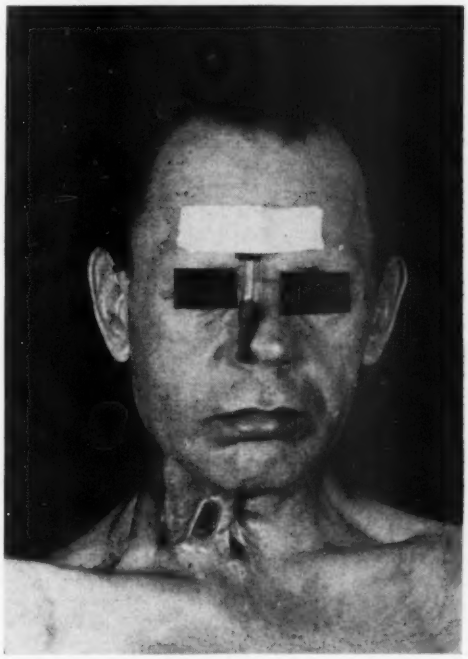

Fig. 1 (Case 1).—Photograph showing a stage in the plastic procedure for reconstruction of the cervical esophagus.

was a minor one in relation to the whole illness, swallowing of the catheter did cause the patient discomfort, and an operation for removal of the tube might have been necessary.

CASE 2.—A white man, aged 62, was admitted to the hospital on March 31, 1951, complaining of a sore throat of seven weeks' duration. He had noted a "lump" in his neck three weeks prior to admission. The patient's medical history yielded no significant information. He had been a steel mill worker at one time, but at the time of admission he

Fig. 2 (Case 2).—Necropsy specimen showing tumor invasion of the common carotid artery under low magnification.

was living in a shanty at the city dump, where he eked out a living by picking up scrap. He smoked about 30 cigarettes daily, and he drank 2 pints of wine per day.

Upon physical examination, the patient appeared in a fair state of nutrition. Firm, tender movable nodes could be felt in the right cervical region. Direct laryngoscopy revealed an ulcerating mass involving the right arytenoid and aryepiglottic fold, with extension to the right pyriform sinus and upper esophagus. The biopsy specimen was reported as moderately differentiated squamous-cell carcinoma.

Surgical treatment was advised. After preliminary preoperative preparation, consisting of intravenous fluids and a course of antibiotic therapy, the operation was performed on April 27, 1951. This consisted of a total laryngectomy, pharyngectomy, partial esophagectomy, and right radical neck dissection.

During the course of the radical neck dissection, it was noted that the carcinomatous mass was closely adherent to the common carotid artery at the point of bifurcation. Grossly, the tumor tissue appeared to invade the wall of the artery. The question arose as to whether the common carotid artery should be ligated and excised with the tumor mass. A neurosurgeon was consulted. He expressed the opinion that ligation of the carotid artery in a patient of this age would probably result in paralysis and possibly death. The consensus was that the carotid artery be left intact.

Pathologic Diagnosis.—The pathologist's diagnosis on the tissue removed at the operation was moderately differentiated squamous-cell carcinoma of the larynx. Sections through the pharynx and the cervical lymph nodes contained tumor tissue morphologically identical with that in the larynx.

Postoperative Course.—Since the tumor tissue in the region of the carotid artery had not been removed, it was decided to have the tumor site irradiated. A total of 3,100 r was given to the right cervical region. Plastic surgery for reconstruction of the esophageal lumen was not attempted, because of the probability that carcinoma involved the carotid artery.

In July, there was clinical evidence of recurrence in the right cervical region. Biopsy confirmed this suspicion. The patient's condition steadily deteriorated, and he died on Feb. 25, 1952.

Necropsy.—Examination of the neck, post mortem, showed that the bifurcation of the right common carotid artery was completely surrounded by the tumor mass. The external carotid artery was greatly narrowed 2 cm. above the bifurcation. The internal carotid artery showed a Z-shaped course at the same level. Figure 2 illustrates the appearance of a portion of the carotid wall invaded by the tumor under low magnification. Figure 3 shows the invasion of the carotid wall by tumor cells under high magnification.

Comment.—The most interesting feature in this case was the problem encountered at operation when it was found that the carotid

Fig. 3 (Case 2).—Necropsy specimen showing tumor invasion of the common carotid artery under high magnification.

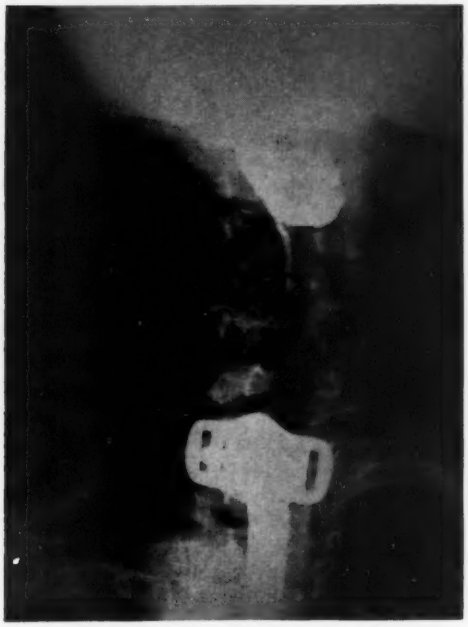

Fig. 4 (Case 3).—Anteroposterior view demonstrating the almost complete obstruction of the esophagus caused by scar-tissue formation.

artery was involved in the carcinomatous invasion. Although the decision in this instance was to leave the carotid artery intact, in retrospect it is justifiable to question the wisdom of this course. From the findings at autopsy, it appears probable that the relatively rapid recurrence of the growth after the operation started from the tumor cells which had invaded the carotid.

CASE 3.—A white man, aged 74, was admitted to the hospital on Sept. 6, 1951, with the complaint of sore throat and hoarseness of eight weeks' duration. The most significant findings upon physical examination were an elevated blood pressure (220/110), cardiac hypertrophy and dilatation (confirmed by roentgenograms), and a firm, fixed palpable anterior cervical node on the right. On direct laryngoscopy a large fungating mass could be seen arising from the right pyriform sinus. Bronchoscopy disclosed no extension into the trachea. The pathologic report on the biopsy specimen was moderately differentiated squamous-cell carcinoma.

The operation performed on Sept. 27, 1951, consisted of a total laryngectomy, right pharyngectomy, including the right pyriform sinus region, and a right radical neck dissection. After removal of the larynx and right pharyngeal wall involved by the tumor, only a narrow strip of mucous membrane connecting the oropharynx to the esophagus remained. However, this was sufficient to permit a primary closure for restoration of an adequate food passage. Toward the end of the operation, when the skin closure was almost complete, there was a sudden massive flow of blood, which flooded the operative area. Digital pressure applied to the supraclavicular region on the right controlled the hemorrhage, while the skin sutures were cut to expose the bleeding point. It was found that the double chromic No. 1 ligatures which had been tied about the distal stump of the internal jugular vein during the course of the neck dissection had slipped off, presumably because of high venous pressure. This time the jugular vein was closed with suture ligatures sewn into the venous wall to prevent them from slipping off the stump. The patient left the table in good condition.

Pathologic Report.—The histological diagnosis of the tissue removed at operation was moderately differentiated squamous-cell carcinoma involving the right pyriform sinus and the right cervical lymph nodes.

Postoperative Course.—The patient's postoperative course was uneventful except for the formation of a fistula leading to the pharynx. The fistula tract was closed by a plastic procedure. He was discharged from the hospital on Feb. 1, 1952, about four months after the original operation and was observed at intervals in the outpatient clinic.

Fig. 5 (Case 3).—Lateral view demonstrating the almost complete obstruction of the esophagus caused by scar-tissue formation.

On July 7, 1952, he was readmitted to the hospital because for about a week he had experienced gradually increasing difficulty in swallowing. The impression of the examining physician was that there was postoperative esophagitis and occlusion of the esophageal lumen, with recurrence of the carcinoma.

Fluoroscopic examination and roentgenographic films showed nearly complete obstruction of the esophagus, with a pouch formation about the level of the fourth cervical vertebra. Figures 4 and 5 show the anteroposterior and lateral films demonstrating the almost complete obstruction of the esophagus.

The patient was given intravenous fluids, and a Levin feeding tube was passed with difficulty. On July 25, 1952, three weeks after admission, he was taken to surgery. The pharynx and upper eosphagus was exposed to view with a long-bladed laryngoscope. It was noted that a band of scar tissue separated the entrance of the esophagus from a sac which projected anteriorly and downward. A small fistula opening could be seen. The stoma leading to the esophagus appeared adequate, and a large bougie was readily passed into the esophagus. On deglutition, it was observed that the scar-tissue band acted like a valve to obstruct the opening to the esophagus. A Bovie unit was employed to cut a V-shaped section of scar tissue from the mid portion of the band. Careful examination of the pharynx and esophagus revealed no evidence of recurrence of the tumor.

The patient was discharged on Aug. 15, 1952, in good condition. He subsequently developed a psychopathic state, which was diagnosed as chronic brain syndrome associated with cerebral arteriosclerosis with psychopathic reaction. He died in a mental institution of cardiovascular disease on July 14, 1953. No gross evidence of recurrence was noted prior to his death.

Comment.—This case brings out three points of interest. The first is that despite the presence of a very extensive lesion, which involved the right pyriform sinus with metastasis to the cervical nodes on the right, it was possible at operation to save sufficient mucous membrane in the pharynx to effect a primary closure of the hypopharynx. Another interesting feature was the hemorrhage that occurred during the closure, caused by the slipping of the ligatures on the jugular vein, stressing the technical point that such ligatures should be sewn into the venous wall to prevent such an occurrence.

The third point of interest, and the most important, was the development of a scar-tissue band as a postoperative complication, which acted like a valve to obstruct the esophageal opening. Unless this possibility is kept in mind, the development of such an obstruction might lead to the suspicion of a recurrence when none is present.

CASE 4.—A white man, aged 52, was first examined on Dec. 13, 1951. He gave a history of weight loss, which began two years previously. Eighteen months prior to admission he began having recurrent sore throats. He treated himself with gargles, lozenges, and the like, but did not seek medical care until he was unable to swallow. He then saw a physician, who made the diagnosis of squamous-cell carcinoma of the pharynx. He received 3750 r to each side of the neck over a period of one month. Since this treatment failed to check the progress of the disease, he was referred for further therapy.

Upon examination, the patient appeared chronically ill and showed cachexia. There was a firm mass on the right side of the neck. On endoscopic examination, an extensive tumor mass involving the right pyriform sinus region, with extension to the upper esophagus and involvement of the right aryepiglottic fold, was seen. In view of the failure of radiation to arrest the growth of the tumor, a radical operation was advised. The operation performed on Feb. 1, 1952, consisted of a total laryngectomy, pharyngectomy, cervical esophagectomy, partial glossectomy, and right radical neck dissection.

During the course of the radical neck dissection it was noted that the tumor mass overlay the common carotid artery at the point of bifurcation. The carotid wall had a dull greenish tint, indicating superficial necrosis with beginning erosion. The question was weighed as to whether the common carotid and the external and internal carotids should be resected. It was deemed advisable not to do this procedure because of the patient's age and his debilitated condition. A heavy black silk untied ligature was placed around the common carotid as a precautionary measure should hemorrhage occur due to rupture of the vessel.

Pathologic Diagnosis.—The pathologic report on the tissue removed at operation was poorly differentiated squamous-cell carcinoma with metastasis to cervical lymph nodes.

Postoperative Course.—The progress after the operation was satisfactory for 10 days. A massive hemorrhage occurred late in the evening. The resident surgeon applied pressure to stop the flow. Upon exposure of the operative wound, a large opening in the carotid artery was found near the bulb. The artery was ligated above and below the

rent in the wall. Left-sided hemiplegia, with left facial and ocular paralysis, developed immediately, and the patient became cold and cyanotic. An infusion of 1,500 cc. of blood was given intravenously.

After this occurrence, the patient's course was progressively downward. The area around the carotid became infected, which added to the deterioration in his general condition. There was some return of function to the upper arm, but the lower extremity remained paralyzed. At no time until the patient's death on June 22, over four and a half months after the operation, was there evidence of recurrence of the carcinoma.

Comment.—In contrast to the majority of patients in this group with advanced pharyngeal neoplasm, this patient had a history of symptoms of long duration (18 months), and had received roentgen therapy for six months before surgery was performed. Because of his poor general condition, no reconstructive plastic procedures were attempted.

In this instance, as in Case 2, the most interesting feature was the invasion of the carotid artery by the tumor mass. Although previous experience should have been a guide, we still lacked courage at the time of operating on this patient to ligate the common carotid artery. This hesitancy was unwarranted, in view of the subsequent rupture of this vessel with massive hemorrhage. If the problem of the carotid invasion had been faced at the operation, this postoperative complication might have been avoided.

CASE 5.—A Negro man, aged 47, sought medical care because of hoarseness, throat irritation, and difficulty in swallowing of three months' duration. He was a chronic alcoholic, but otherwise his past history was not significant. Direct laryngoscopy revealed a lesion involving the right base of the epiglottis, with extension into the vallecula. The pathologic report on the biopsy specimen was well-differentiated squamous-cell carcinoma. The operation performed on June 10 consisted of a right pharyngectomy, excision of the epiglottis, right partial glossectomy, and right radical neck dissection.

Pathologic Diagnosis.—The histologic diagnosis was squamous-cell carcinoma, with keratinization involving the stratified epithelium and fibroadipose tissue and lymph nodes.

Postoperative Course.—A plastic repair of the pharyngeal stoma, which was left open at the time of operation to permit direct observation of the tumor site, was done on July 25, 1952. Figure 6 shows the appearance of the patient just before this procedure was done. Two months later the patient began complaining of pain deep in his throat. Pharyngoscopy revealed a suspicious induration in the remaining portion of the tongue. A biopsy specimen taken from this area revealed recurrence of the neoplasm. Soon afterward enlarged nodes could be felt on the contralateral side, indicating widespread metastasis. Further surgery was deemed inadvisable. The patient was given a course of irradiation therapy, which failed to check the disease. He was discharged to a nursing home and followed up in the outpatient clinic. When he was last seen, in September of 1953, his physical condition was gradually declining, but he was able to tolerate a soft diet and complained of little pain. The larynx appeared free of cancerous invasion.

Fig. 6 (Case 5).—Appearance of patient just before operation for closure of fistula leading to the pharynx.

Comment.—The recurrence of the carcinoma at the line of excision of the base of the tongue is another example of insufficient removal of tissue, even though at the time of operation it was felt that adequate surgery had been performed. The decision not to remove the larynx seems to have been justified because that organ remained free of neoplastic invasion, thereby illustrating that adequate surgery does not imply ruthless sacrifice of normal structures.

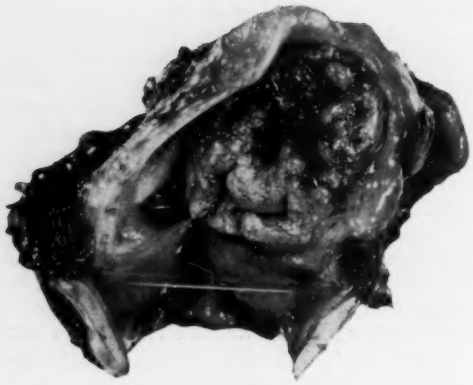

Fig. 7 (Case 6).—Specimen removed at operation showing the extent of the primary lesion.

Case 6.—A Negro man, aged 46, was seen in the outpatient department on July 10, 1952, complaining of hoarseness of four months' duration. He likewise noted progressive difficulty in swallowing. Upon examination the patient was found to be markedly dehydrated and undernourished. He likewise showed signs of advanced arteriosclerosis and general debility. His appearance was that of a 75-year-old man rather than a man of 46.

Direct laryngoscopy revealed a large fungating mass invading the right side of the larynx, right aryepiglottic fold, and extending into the pyriform sinus. A biopsy specimen taken from this area was reported as squamous-cell carcinoma.

After a prolonged period of preoperative preparation to improve the patient physically, he was subjected to surgery on Sept. 17, 1952. The operation consisted of a total laryngectomy, excision of the right pyriform sinus area, and a right radical neck dissection. Figure 7 shows the specimen removed at operation.

Pathologic Diagnosis.—The histological diagnosis of the tissue removed at operation was poorly differentiated squamous-cell carcinoma involving the entire right side of the larynx and right pyriform sinus. The cervical glands removed in the neck dissection showed the presence of metastatic nodules.

Postoperative Course.—The patient's postoperative course was remarkable. His general condition began to improve soon after the operation. On the 10th postoperative day he began to swallow liquids and tolerated a soft diet 2 days later. He gained steadily in weight and strength. Upon discharge on Nov. 17, 1952, he weighed 125 lb. (57 kg.) and showed no evidence of recurrence.

Comment.—This case is an outstanding example of how modern preoperative care can build up a severely debilitated patient so that he can withstand adequate surgery. The most remarkable feature was the great improvement in the patient's condition following surgery. Even should he suffer recurrence, the alleviation of symptoms which he obtained following surgery made the procedure worth while. The patient has been free of recurrence for one year.

Case 7.—A white man, aged 68, was admitted to the hospital because of a sore throat and difficulty in swallowing of three months' duration. There was nothing significant in his past history relating to the present condition. Direct laryngoscopy revealed that the epiglottis was invaded by a fungating mass, which extended into the vallecula and base of the tongue. The biopsy report was squamous-cell carcinoma moderately well differentiated.

An operation, consisting of total laryngectomy, partial glossectomy, and left radical neck dissection, was performed on Aug. 27. The specimen removed at operation is shown in Figure 8.

Pathologic Diagnosis.—The histologic diagnosis was squamous-cell carcinoma of the larynx and hyperplasia of the lymph nodes. Sections of the hyoid bone, tissue from the base of the tongue, the thyroid cartilage, skeletal muscle, and lymph nodes were free of tumor involvement.

Postoperative Course.—The patient's postoperative course was uneventful. He began to take food by mouth on the eighth postoperative day and was discharged on Sept. 5, 1952.

Fig. 8 (Case 7).—Specimen removed at operation showing the extent of the primary lesion.

The patient's general condition steadily improved. He gained in weight and resumed his old employment. In July, 1953, he was readmitted to the hospital because of urinary retention due to prostatic hypertrophy. The transurethral resection was successful. There was no evidence of recurrence of carcinoma, and the patient has been free of recurrence for a period of one year.

Comment.—This case is another illustration of an extensive lesion removed by adequate surgery followed by alleviation of symptoms and a possible cure. Despite the extent of the lesion, it was possible to achieve primary closure, thereby considerably shortening the period of hospitalization.

ANALYSIS OF CASES

Material.—The cases reported represent a group of patients with advanced carcinoma of the phaynx, larynx, or cervical esophagus. Such cases were formerly treated only with radiation. Six of the series were treated in two teaching institutions, where a group of laryngologists had an opportunity to observe their preoperative and postoperative courses; one was treated as a private patient in a private hospital. The majority of the patients showed varying degrees of debility and emaciation. The extensive spread of the primary disease made exact localization of the site of origin problematic. Hilton [49] encountered the same difficulty when attempting to compare results of carcinoma of the pharynx. On the basis of history and endoscopic examination, the cases were divided as follows:

1 case of carcinoma involving the cervical esophagus with extension to the larynx

2 cases of carcinoma originating in the right pyriform sinus with extension to the adjacent structures

2 cases of carcinoma involving the base of the epiglottis with extension to the base of the tongue

1 case of extrinsic carcinoma of the larynx with extension to the right pyriform sinus and upper esophagus

1 case of extrinsic carcinoma of the larynx with extension to the right pyriform sinus

One of the patients had previously received radiation therapy, which failed to check the course of the disease.

Symptomatology.—The outstanding feature of the symptomatology presented by the patients in this series was the relatively late onset of symptoms, even though the disease was extensive. The longest duration of symptoms was 18 months and the shortest was seven weeks.

Dysphagia was the outstanding complaint. In regard to the onset of dysphagia, Ahlbom [50] states, "The dysphagia is in many cases so slight that it requires a very careful questioning in order to establish its presence." In three of the cases it was preceded by a vague tickling sensation, which was more annoying than painful. These early signs were followed by progressive difficulty in swallowing.

Recurrent sore throats which failed to respond to the usual treatment regimen, such as the use of gargles and lozenges, was next in importance. Three patients cited sore throats as the first symptom which made them aware of any difficulty in the throat. Hoarseness was a relatively late symptom and was the chief complaint in only one case of the series. Most of the patients noted difficulty in swallowing late in the disease. Pain was not an outstanding symptom, and it did not occur until shortly before medical care was sought.

Etiology.—The age incidence was the only finding in the series which bore any relation to etiology. The ages ranged from 46 to 74, with an average age of 57. All were males. In only one instance could the occupation have been a factor, though a very doubtful one. The patient concerned was a glazier by trade, who claimed he had been grinding glass and inhaling much of the dust for five months prior to the onset of his symptoms. The neoplasm in this case originated in the cervical esophagus. The economic status of the patients, an incidental finding with little, if any, bearing on etiology, was in the indigent and low income classification.

Diagnosis.—When the patients were first seen, the lesions were so far advanced that the diagnosis was obvious. In no instance could a family physician be blamed for overlooking the diagnosis or mistreating the case.

Such treatment as was taken was self-administered. The economic status could not be blamed, because all the patients had access to free medical care in the outpatient clinics. Pilcher [51] states that the pressing need is for early diagnosis, yet our experience would indicate that this goal can not be achieved until lay education in the early signs and symptoms of cancer becomes widespread.

Pathology.—All the cases in the series were diagnosed by the pathologist upon microscopic examination as squamous-cell carcinoma, with varying degrees of differentiation. Only one case (Case 7) upon histologic examination failed to show metastasis to the cervical lymph nodes removed at the time of operation.

Preoperative Care.—All the patients routinely received a course of penicillin or other antibiotics prior to undergoing surgery. Careful attention was paid to fluid and electrolyte balance, and adequate measures were taken to correct any deficiencies. Internists were called in consultation to determine the physical status of each patient before an operation was attempted. What can be accomplished by modern preoperative care was demonstrated in Case 6. This patient was hospitalized for a period of two months, during which time he received numerous infusions and a number of blood transfusions before he was declared a fair risk for surgery. He withstood an adequate surgical procedure without incident and was alive without evidence of recurrence when last seen.

Operative Procedures.—No claim is made to originality in the operative procedures carried out in this series. The techniques used were those described by Wookey, Trotter, Orton, and others.

The operative procedures carried out were as follows:

3 Cases—Total laryngectomy, pharyngectomy, cervical esophagectomy. A partial plastic repair was done in one case before the patient died of recurrence. The two other patients died before plastic repair could be attempted.

2 Cases—Total laryngectomy and partial pharyngectomy with primary repair.

1 Case—Total laryngectomy with partial glossectomy and primary repair.

1 Case—Partial pharyngectomy with removal of the epiglottis and partial glossectomy. Larynx was left intact.

All the cases had a radical neck dissection done at the time of the operation for the removal of the primary growth.

Postoperative Care.—The patients were kept on antibiotics for varying periods following the operation, depending on wound healing. No complications due to infection occurred in this series. Nursing care was provided by nurses accustomed to handling tracheotomized patients. The average hospital stay was 187 days, an unusually high figure. Its significance will be considered later.

Results.—Of the entire group, two patients were living and free of recurrence one year after they were operated upon. Another patient who was still alive 15 months after his operation developed a recurrence. One patient survived 22½ months and died of cardiovascular disease, with no evidence of recurrence. Another patient survived four and one-half months after operation but died of complications following rupture of the common carotid artery. He showed no gross evidence of recurrence. (Autopsy was not performed.) Two patients died of recurrence, one 9 months and the other 11½ months after surgery.

COMMENT

Problems encountered in adequate surgery for advanced carcinoma of the pharynx, larynx, and cervical esophagus were presented in this series of cases. Since the observations made in the course of our experience in doing this type of surgery might be helpful to others, they deserve more discussion than the mention made of them in the Comment after each individual case and in the Analysis of Cases.

The importance of careful preoperative preparation of the patient can not be overemphasized. Proper attention to fluid and electrolyte balance is essential. Even though the need for surgery is most pressing, be-

cause of the invasive character of the primary disease, proper preoperative preparation must take precedence. No operative deaths occurred in the series, even though the patients when first seen showed moderate to marked degrees of debility from effects of the disease. The contributing factor to the absence of an operative mortality was attention to proper preparation of the patient for surgery. Case 6 is cited as an example. In this instance two months elapsed before it was felt that the patient could withstand the operation, which he did, without incident.

The outstanding problems encountered were met in the course of the operative procedures. A technical error worth mentioning was made evident in Case 3 when a massive hemorrhage occurred, while the patient was on the operating table, because two ligatures which had been tied about the proximal end of the jugular vein had slipped. In subsequent operations, transfixion suture ligatures were used.

In analyzing the failures, in the sense of recurrence, it appeared evident that in Cases 1 and 5 insufficient amounts of tissue were removed at the time of operation. In Case 1 an effort was made to conserve as much tissue as possible. However, since the recurrence was situated about the esophageal stump, in retrospect it would appear that more of this structure should have been removed. In later cases in which the upper esophagus was involved a wider resection was carried out. In Case 5 a more complete partial glossectomy or perhaps a hemiglossectomy should have been done. The decision not to sacrifice the larynx was justified, for to the time of writing this organ had remained free of malignant growth.

Two failures (Cases 2 and 4) were directly related to a perplexing problem, namely, whether or not to ligate the common carotid when that vessel showed evidence of invasion by the neoplasm or if changes in the vessel wall indicated possible rupture of the vessel. Since, as Beck and Guttman [52] point out, the carotid and supraclavicular nodes are most frequently involved when metastasis occurs, this problem must arise not infrequently in the experience of others. In this small series of cases it occurred twice. In both instances the decision at operation was not to ligate the common carotid, with results which indicated that it might have been better if this artery had been tied off. In Case 2, there was rapid extension of the malignant growth after operation, which caused the death of the patient 10 months after this procedure. In Case 4, the tumor caused erosion of the carotid artery with a massive hemorrhage 10 days after the operation, for which ligation of the carotid had to be done as a life-saving measure, and the patient lived only four and one-half months.

Ligation of the common carotid artery, particularly in older persons, is a serious problem, for it may result in hemiplegia and even death. Martin and associates [46] state that if there were a possibility to determine preoperatively whether the carotid artery is involved in the malignant process, the decision should be against performing the radical neck dissection. However, in most cases certainly this can not be ascertained until the operation is in process. Martin and his colleagues have this to say about the dilema which faces the surgeon under these circumstances:

> Technically, the excision of the artery is not difficult, but the complications following the interruption of this portion of the arterial circulation are serious. No matter what precautions are taken either before or after the operation, the postoperative mortality following interruption of the circulation in the common or internal carotid artery is between 40 and 50 per cent, either immediately or within the first few postoperative days.

Recent works by Conley || offer a hopeful solution to the problem involved. He described three surgical techniques for the management and prevention of the serious complications of hemiplegia, coma, and death as a result of cerebral ischemia following ligation of the common carotid artery. These techniques consist of (1) the anastomosis of an autogenous vein graft to the common and internal carotid arteries, (2) the ipsilateral anastomosis of the distal severed end of the

|| References 53 and 54.

internal and external arteries, and (3) the use of large tissue flaps to cover and nourish an ulcerating carotid artery or protect and nourish anastomosis. Conley and Pack [55] described the technique of free autogenous vein graft to the internal and common carotid arteries in the treatment of tumors of the neck with 11 cases presented. The technique of ipsilateral anastomosis could readily have been carried out in both of our cases, but Conley's techniques were not known to us at that time.

The importance of good nursing care in the postoperative period cannot be overemphasized. The accidental swallowing of the feeding tube by one of the patients with an esophageal stoma in the neck points to a possibility which must be guarded against. The patient insisted upon feeding himself and had been in the habit of inserting the tube into the stoma at each feeding. The use of antibiotics in the postoperative period was the primary factor in reducing complications from infection, thereby hastening recovery of the patients. No irradiation was given postoperatively, for we felt, like Simpson,[56] that it is better to place reliance on postoperative observation than to embark upon immediate routine postoperative irradiation.

Case 3 presented a complication which became evident 10 months after the primary operation. A scar-tissue band developed at the line of closure of the pharyngeal stoma, which acted like a valve to close off the esophagus, thereby diverting the food into a diverticulum which had formed anterior to the esophageal opening. The clinical impression gained from the history was that recurrence was obstructing the food passage. X-ray studies and endoscopic examination revealed the true nature of the patient's difficulty in swallowing. The band was readily resected by electrosurgery, resulting in complete relief of the patient's dysphagia. We have observed a similar complication develop in a patient who had a total laryngectomy done elsewhere for carcinoma.

Pertinent facts must be presented in order to avoid any misconceptions which might arise concerning the significance of the average number of days (187 hospital days) spent in the hospital by the patients presented in this series of cases. As stated in the Analysis of Cases, the patients came from the indigent and low income class group. Four of them had no family or homes to which they could be sent for care until such time as they required for readmission for plastic procedures. For the same reason patients with recurrence were kept in the hospital until they died. Relatives of the other patients were reluctant to accept them because they claimed that family funds were inadequate to provide the special diet and care needed by the patients. These factors contributed materially to making the figure of average days spent in the hospital so high. Had proper home environments been available, the prolonged hospital stay would not have been necessary in most instances.

Dunlop [2] states:

> The justification of mutilating surgery is the absence of a satisfactory alternative, but it can only be faced with equanimity when attended by a low operative mortality, and reasonable prospects of alleviation or cure. The former condition now obtains, but there are cases so advanced when they first seek aid that cure is out of question, even by the most radical methods of excision. Only time will show whether more recently introduced methods represent worthwhile alleviation in these cases.

In this series of cases there was no operative mortality, even though most of the patients were poor surgical risks. This series of cases can not be presented to show successful results from adequate surgical treatment because, with the exception of Case 1, all the operations were performed within the last two and a half years.

However, from the standpoint of alleviation of symptoms, some degree of success was achieved. It must be stressed that the primary purpose in subjecting this group of patients to adequate surgery was to obtain a cure. The alleviation of symptoms was of secondary consideration. Nevertheless, a group of competent laryngologists observed similar patients with this disease who were not treated by adequate surgery and this group who had been subjected to adequate

surgery. Their consensus was that the latter group suffered less pain and discomfort than did the former.

SUMMARY

A concept of surgery as it pertains to advanced carcinoma of the pharynx, larynx, and cervical esophagus is presented. The terms adequate and inadequate surgery are proposed and their meanings defined. Criticism made against this type of surgery is discussed. A historical review of the subject is presented.

Seven cases are described in detail and an analysis of pertinent data made. A discussion of the problems encountered in this type of surgery is presented. Particular reference is made to the problem of the common carotid artery when that structure is found to be invaded by a metastatic tumor at the time of operation.

Of the seven cases cited, two were living and free of recurrence one year after operation. One patient was alive 15 months after operation but had developed an inoperable recurrence. Two patients died of recurrence. Two died of causes other than recurrence.

Although the primary purpose in operating upon this group was to achieve a cure, the alleviation of symptoms obtained by the patients proved to be added justification for the performance of adequate surgery for advanced carcinoma of the phaynx, larynx, and cervical esophagus.

9119 Miles Ave. (5).

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MOBILIZATION OF THE STAPES FOR OTOSCLEROTIC DEAFNESS

Preliminary Report on Two Years' Experience

SAMUEL ROSEN, M.D.
and
MOE BERGMAN, Ed.D., New York

MOBILIZATION of the ankylosed footplate of the stapes in otosclerotic deafness has been employed for the past two years to restore hearing. The following report of this work is presented at this time to answer two questions which are basic in the evaluation of any surgical technique for the relief of deafness: first, can the operation restore socially useful unaided hearing; and second, will the restored hearing last?

In a recent publication one of us (S. R.) [1] described a method of palpating the stapes as a means of determining suitability for fenestration. This was done through an ordinary ear speculum in the external auditory canal with the area under local anesthesia. After the lower half of the drum membrane was elevated and the incudostapedial joint exposed, the degree of fixation of the stapes was determined by palpating it with a probe.

On April 3, 1952, the above procedure of palpation of the stapes in a case of otosclerotic deafness suddenly resulted in a return of acute hearing. It seemed that while this fixed stapes was being palpated the footplate was accidentally mobilized. This patient had been carefully studied in several audiology centers prior to this incident and had been found to be ideal for the fenestration operation. Hearing tests made shortly after the mobilization of the stapes revealed normal hearing, which has been maintained to the time of this writing. This case (Case 1, E. L.) is described fully in the Report of Cases.

From the Otolaryngological Service, Mount Sinai Hospital (Dr. Rosen); Hunter College (Dr. Bergman).

Recognizing the obvious advantages of utilizing nature's own pathway of sound conduction via the intact and freely moving ossicular chain, one of us (S. R.) developed and employed a technique with special instruments for the deliberate mobilization of the fixed footplate of the stapes.*

HISTORICAL BACKGROUND

Kessel [4] in 1876 attempted unsuccessfully to improve hearing in cases of stapes ankylosis resulting from suppuration by removing the drum membrane, malleus, and incus. Later Kessel unsuccessfully tried mobilization and complete removal of the stapes. Boucheron [6] in 1888 reported mobilization of the stapes in 60 cases after separating the incus from the stapes and excising the posterior half of the drum. Miot [7] in 1890 obtained slight, and only temporary, improvement in 200 cases of stapes mobilization. In some cases he operated on the same ear three times within the first few months. Siebenmann [8] in 1900 stated that all operations on the stapes, mobilization or stapedectomy, were useless. Faraci [9] in 1899 reported some success with mobilization. Others attempted various operations to mobilize or extract the stapedial footplate. In America, Blake (1891-1893),† Jack,‡ and Burnett [20] similarly employed mobilization of the stapes but soon turned to stapedectomy. All these operations upon the stapes were performed through a myringotomy opening. They were finally abandoned over 50 years ago in favor of attempts to create a new window into the labyrinth, which resulted in Lempert's present-day fenestration operation.

* References 2 and 3.

† References 10 to 13.

‡ References 14 to 19.

TECHNIQUE

The method consists of exposing the stapes through an ear speculum in the external auditory canal, with the area under local anesthesia, using the Zeiss binocular loupe. The lower half of the drum membrane is lifted out of its sulcus and folded upward upon itself, thus exposing the contents of the tympanic cavity. This technique is similar to the one employed for section of the chorda tympani nerve for Ménière's disease.[21] The patient is given pentobarbital (Nembutal), 1½ grains (90 mg.), an hour before operation. One to 2 cc. of a mixture of 3 parts of 2% lidocaine (Xylocaine) hydrochloride to 1 part of epinephrine chloride, 1:1000, is injected (in equal amounts) subcutaneously into the posterior, superior, anterior, and inferior walls of the external canal at the junction of the cartilaginous and bony canals. An incision is made through the skin over the bony canal wall, beginning at about 9 o'clock and continuing downward and around to 3 o'clock on the right ear and vice versa on the left, about 6 to 7 mm. external to the drum (with instrument No. 1, Fig. 1). The skin is separated from the bone as far as the drum (with instruments Nos. 2 and 3), starting the separation at the beginning of the incision; the drum is finally lifted out of its sulcus and reflected upward upon itself like an apron (with instrument No. 4). In over 85% of the cases the incudostapedial junction is seen at once. However, about 2 to 3 mm. of the very edge of the posterior bony canal, just external to the incus, is removed (with instrument No. 5) in order to get a much wider exposure, especially of the stapedial tendon, which is inserted into the neck of the stapes. This makes clearly visible almost all of the long process of the incus, the incudostapedial junction, the head, neck, sometimes the crura and footplate of the stapes, facial canal, stapedius tendon, chorda tympani nerve, a portion of the incudomalleolar articulation, and the inner aspect of the hammer handle.

To test for mobility of the footplate of the stapes, a finely pointed probe (instrument No. 6) is placed against the long process of the incus close to its articulation with the stapes and moved gently downward for a fraction of a millimeter. When the footplate of the stapes is freely movable in the oval window, the gentlest pressure of the probe against the long process of the incus causes free and unimpeded movement of the incus, incudostapedial joint, the head, neck, crura of the stapes, and the stapedial tendon. The tendon of the stapedius is the structure to watch at all times, since its movement is the reflection of the footplate movement. The footplate of the stapes moves invariably whenever the head and crura move, and when this happens, the tendon invariably moves in proportion to the movement of the stapes. These structures can all be seen to move together as one. The operator can also feel these structures moving. This associated sight and feel must be experienced often to master the technique (preferably on 50 fresh cadavers). When the stapes is partially fixed, it takes greater pressure of the probe against the long process of the incus to move the above structures only very slightly, as measured again by the degree that the tendon can be seen to shorten and lengthen. Again, these structures can be seen to move together as one, however minutely. But when

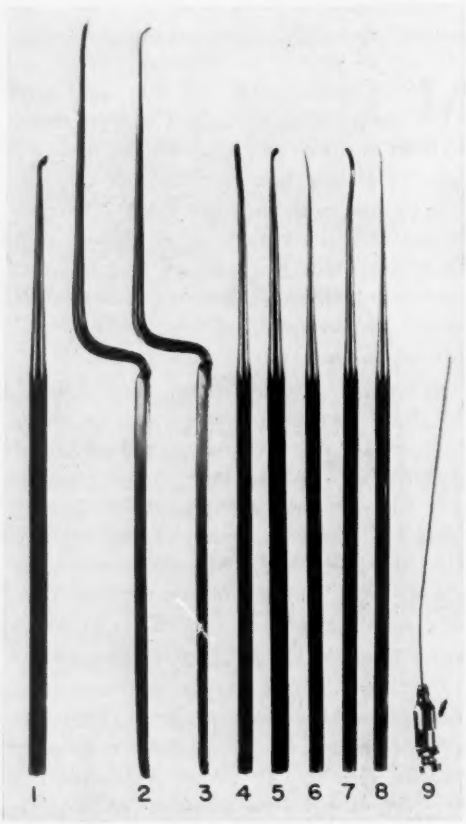

Fig. 1.—Instruments used in mobilization of the stapes shown in sequence, as described in the text.

the footplate of the stapes is completely fixed, very firm pressure of the probe against the long process of the incus causes the incus alone to move but there is no movement whatever of the head, crura, footplate, or tendon of the stapes (Fig. 2).

When the stapes is rigidly fixed, variable pressure downward against the neck (only the neck) of the stapes may suddenly loosen the footplate, with immediate improvement in the hearing. For this purpose a specially curved, narrow mobilizer is used (instrument No. 7). The palpating edge of

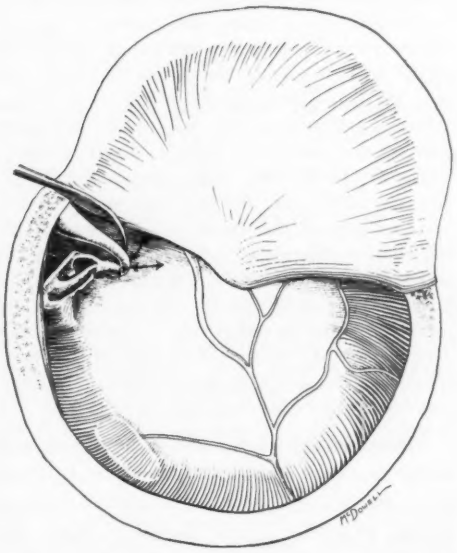

Fig. 2.—The drum membrane is folded upward upon itself, thus exposing the stapes for manipulation.

the mobilizer is first inserted over the incudostapedial joint and is carried mesially and inferiorly until one can feel the anterior crus of the stapes close to the footplate. The instrument is pulled slowly upward and outward, hugging the anterior crus until one suddenly feels a dent or depression, which is the neck of the stapes. At this point the stapes withstands the greatest pressure without fracture of the crura[2] (Fig. 3). Pressure downward in the line of the stapedial tendon is made until the stapes is mobilized, sometimes with an audible crack. The direction of the stapedial tendon roughly follows the same direction as the crura and the long axis of the footplate. Less pressure on the neck of the stapes is needed to mobilize the less fixed footplate than the extremely rigid footplate. The amount of pressure which can be exerted on the neck of the stapes without fracturing the crura is considerable (Fig. 4). If during the procedure adhesions involving the ossicles are encountered, they may be severed (instrument No. 8). A rounded and slightly bent spinal tap needle is used for suction (instrument No. 9).

Fig. 3.—Stapes mobilizer exerting its force against the neck of the stapes to free the footplate.

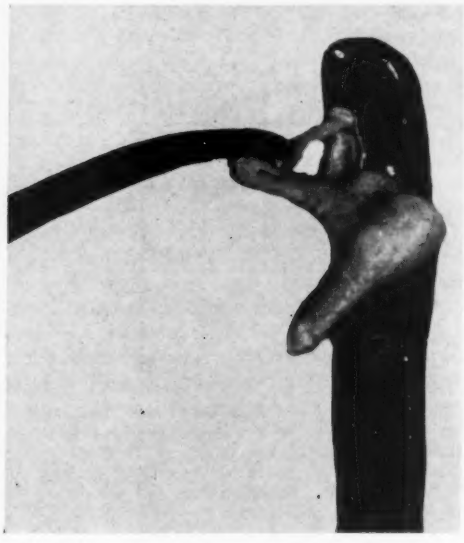

Fig. 4.—Eight-ounce (227-gm.) weight suspended from neck of stapes. In 31 stapes thus tested the maximum weight suspended from the neck of the stapes before crural fracture was noted. The arithmetical mean of the weight was 166 gm., with a standard deviation of 58 gm. The pressure exerted by the surgeon against the neck of the stapes is in a similar direction as that exerted by the suspended weight, and the force used in surgical manipulation is less.

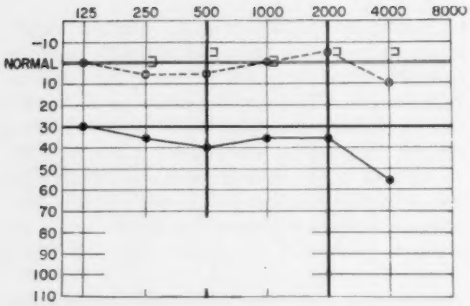

Fig. 5 (Case 1, E. L.).—The solid line indicates the air-conduction audiogram of the left ear taken just before mobilization. The broken line shows the air-conduction audiogram of the same ear 25 months after mobilization. The preoperative bone conduction is also shown. Speech-reception threshold: before mobilization, 40 db.; 25 months after mobilization, 5 db.

After the stapes is mobilized the intact eardrum and attached skin are finally put back in their original positions. Healing of the skin of the canal is usually complete in about a week. Antibiotics are given for five days after the operation, when the dressing is removed. The patient is ambulatory the day of operation, without vertigo, is on a full diet, and leaves the hospital the following morning.

REPORT OF CASES

Case 1.—E. L., a married man of 43, in good health, had bilateral progressive deafness for many years, more marked in his left ear. His mother and maternal grandmother had been deaf for a great many years. High-pitched tinnitus was present at times. Pure-tone and speech audiometry had previously been done by outstanding otologists at various times in various parts of the country, all of whom suspected otosclerosis as the cause of his deafness and leaned toward fenestration. He was referred to one of us (S. R.) for fenestration. When palpation of the stapes as a means of determining its degree of mobility, and therefore his suitability for fenestration, was explained to him, he decided to postpone the fenestration operation until after the stapes was first palpated. On April 3, 1952, this was done. Firm pressure downward against the long process of the incus close to the stapes revealed only the very slightest movement of the head and crura of the stapes and the stapedius tendon (incomplete ankylosis), whereas similar pressure against the neck of the stapes caused greater movement of the head, crura, and tendon of the stapes. Suddenly, while the neck of the stapes was being repeatedly palpated, the patient said: "I can hear everything now, things I haven't heard for so many years." This phenomenon was identical with the sudden return of acute hearing at the completion of the artificial fenestra during the fenestration operation. His drum membrane was then placed back in its normal position. The patient was ambulatory the day of operation, and on a full diet. There was no postoperative vertigo. When his loss for pure tones was tested three weeks after the operation, the hearing had reached a level within 10 db. of normal for tones up to 2000 cps. The speech-reception threshold before stapes mobilization was 40 db. Three weeks after mobilization of the stapes the speech-reception threshold was 10 db. One year after operation, his pure-tone loss averaged within 5 db. of normal and his speech-reception threshold was 10 db. in the ear operated on. At the end of 25 months, his pure-tone loss averaged 5 db. and his speech reception threshold was 5 db. (Fig. 5).

Manipulation of the stapes loosened and made freely movable the incompletely fixed footplate. Restitution of the normal physiological function of the ossicular chain, including the freely movable footplate of the stapes, resulted in normal hearing in this case. Similarly, normal hearing also followed mobilization of the completely fixed stapes in Case 2. Mobilizing the footplate of the stapes restores the elements which nature has provided for normal physiological hearing—a movable footplate of the stapes in nature's own oval window and an intact ossicular chain.

Case 2.—A. M., aged 22, a soldier in the Israeli Army, had bilateral progressive deafness and tinnitus, which he noticed had become rapidly worse for more than one year. Audiometric tests revealed

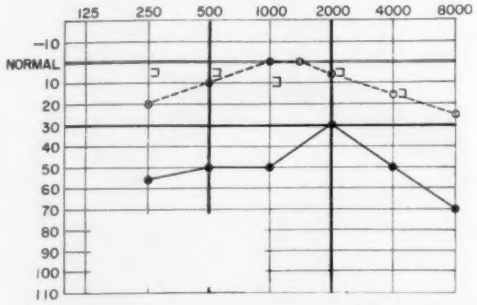

Fig. 6 (Case 2, A. M.).—The solid line indicates the air-conduction audiogram of the left ear before mobilization. The broken line shows the air-conduction audiogram of the same ear 21 months after mobilization. Preoperative bone conduction is also shown. Speech audiometry was not performed due to a language problem.

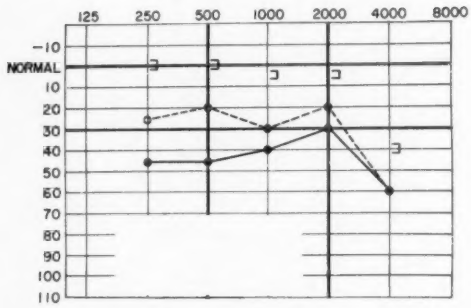

Fig. 7 (Case 3, P. S.).—The solid line indicates the air-conduction audiogram of the left ear just before mobilization. The broken line shows the air-conduction audiogram of the same ear 22 months after mobilization. Preoperative bone conduction is also shown. Speech-reception threshold: before mobilization, 45 db.; 22 months after mobilization, 30 db. The improvement was moderate.

typical conduction deafness, with average pure-tone loss of 43 db. and with normal bone conduction. The operation was performed at the Military Hospital, Tel Aviv, on Aug. 17, 1952, at which time I was on a medical mission for the Israeli government. The left stapes was found to be completely fixed. Manipulation mobilized the stapes, with dramatic return of hearing on the operating table. Within two weeks the hearing reached the normal level for pure tones. At the end of 21 months the hearing for pure tones had remained normal (Fig. 6).

CASE 3.—P. S., a housewife, aged 45, had bilateral progressive deafness for 15 years. There was no family history of deafness. The hearing became worse after childbirth, in 1946. On Jan. 14, 1947, examination of the right ear revealed an average pure-tone loss of 55 db. and normal bone conduction. Right fenestration on March 13, 1947, resulted in improved hearing to the 20-db. level, which was maintained until the fall of 1951, when there developed a persistent perforation in Schrapnell's membrane following an upper respiratory infection. The hearing in the fenestrated ear fell to below the 30-db. level. Since this patient referred Case 1, E. L., to me and observed the result of mobilizing his stapes, she requested that I try to mobilize her left stapes (unfenestrated side). This was done July 7, 1952. The stapes was found to be almost completely fixed. Manipulation of the neck of the stapes mobilized it so that the incudostapedial joint, head, neck, and tendon of the stapes could be seen to move together freely. Her hearing improved on the operating table. She was ambulatory the day of operation, was on a full diet, and had no postoperative vertigo. She left the hospital the next day. At the end of 22 months the moderate improvement in hearing had been maintained (Fig. 7).

CASE 4.—Y. R., a 28-year-old physician, whose mother was deaf for many years, had progressive deafness for over 10 years. The right ear was fenestrated in 1945 in Bucharest, Romania. Almost total deafness in this ear ensued after the operation. Facial palsy, which occurred during the operation, recovered in six months. Tinnitus was severe in both ears. On Aug. 10, 1952, the left tympanum was explored and palpation revealed the left stapes (on the unfenestrated side) to be rigidly fixed. It was mobilized. Hearing dramatically improved on the operating table. The hearing by air conduction in the left (unfenestrated) ear before mobilization of the stapes showed an average pure-tone loss of 82 db. Hearing by bone conduction, though poor, indicated the possibility of improving his hearing to the degree that the conductive element might be removed. The hearing by air conduction postmobilization showed an average loss of 47 db. for 500 through 2000 cps, with hearing at 20 to 25 db. at 125 and 250 cps, respectively. As soon as the stapes became mobile, the patient excitedly reported hearing room sounds and voices. The improvement is significant in terms of the value to be derived from the use of a hearing aid. In other words, the patient presented a mixed conductive and perceptive deafness. Mobilization of the stapes apparently removed the conductive deafness, leaving the perceptive deafness. At the end of 21 months the hearing was at a level which permits successful use of a hearing aid. Before mobilization of the stapes the patient was unable to realize practicable hearing with a hearing aid.

CASE 5.—L. B., a 31-year-old machinist, had bilateral progressive deafness for several years. Hearing loss was about the same in both ears: for pure tones 48 db. in the left ear and 43 db. in the right

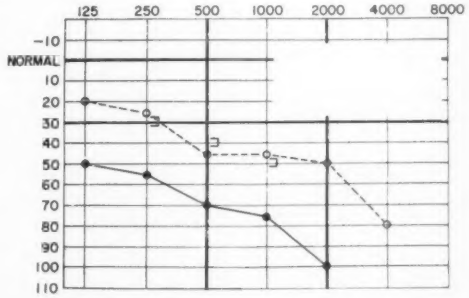

Fig. 8 (Case 4, Y. R.).—The solid line indicates the air-conduction audiogram taken just before mobilization of the left stapes. The broken line shows the air-conduction audiogram 21 months after mobilization. The air-bone gap (conductive deafness) present before mobilization appeared to have been closed. The nerve deafness remained unaffected. The other (right) ear had previously been fenestrated unsuccessfully. Speech audiometry was not performed due to a language problem.

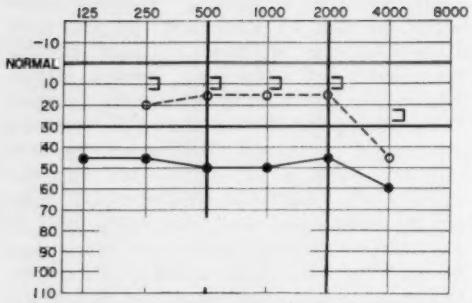

Fig. 9 (Case 5, L. B.).—Bilateral stapes mobilization of the left ear. The solid line shows the air-conduction audiogram just before the left stapes was mobilized. The broken line shows the air-conduction audiogram 17 months after stapes mobilization. The preoperative bone conduction is also shown. The speech-reception threshold 17 months after mobilization was 15 db.

ear. The preoperative bone conduction in the left ear was 10 db. and in the right ear 15 db. On Sept. 9, 1952, his left stapes was found to be partially fixed. It was mobilized, and then it moved freely. The hearing improved markedly on the operating table. The patient was ambulatory the day of operation, was on a full diet, and had no postoperative vertigo. He left the hospital the next day. The other ear was operated on similarly on Jan. 6, 1953, with the same findings and the same improvement in hearing. At the end of 17 months

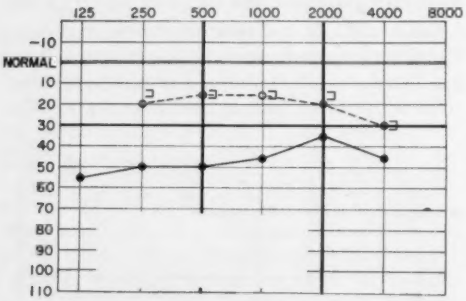

Fig. 10 (Case 5, L. B.).—Bilateral stapes mobilization of the right ear. This patient's right stapes was mobilized four months after the left, shown in Figure 9. The solid line shows the air-conduction audiogram before the stapes was mobilized. The broken line shows the air-conduction audiogram 13 months after stapes mobilization. The preoperative bone conduction is also shown. The speech-reception threshold 13 months after mobilization was 15 db.

and 13 months, respectively, the improvement in hearing in both ears had been maintained (Figs. 9 and 10).

Case 6.—A. S., a housewife, 57 years of age, in good health, was seen in the outpatient department. She had bilateral progressive deafness for many years, which became much worse in the past three years. Tinnitus was present only occasionally. The average loss for pure tones in the right ear was 53 db., with an average loss by bone less than 15 db. On Jan. 15, 1953, her right stapes was

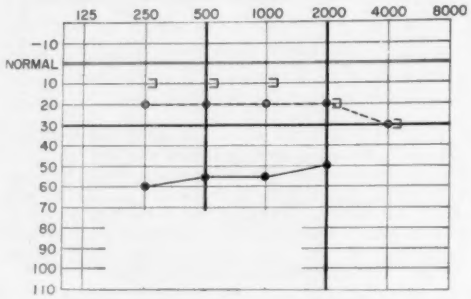

Fig. 11 (Case 6, A. S.).—The solid line indicates the air-conduction audiogram of the right ear taken just before mobilization. The broken line shows the air-conduction audiogram of the same ear 16 months after mobilization. The preoperative bone conduction is also shown. The speech-reception threshold 16 months after mobilization was 15 db.

found to be rigidly fixed. The stapes was mobilized, with immediate return of hearing on the operating table. The patient was ambulatory the day of operation, had no postoperative vertigo, and left the hospital the following day. At the end of 16 months the hearing gain had been maintained (Fig. 11).

Case 7.—C. M., a female secretary, 40 years of age, in good health, had progressive bilateral deafness for about 10 years, with occasional tinnitus in both ears alternately. The average pure-tone loss in the left ear before mobilization was 45 db., with

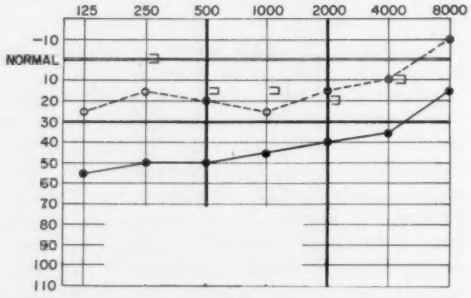

Fig. 12 (Case 7, C. M.).—The solid line indicates the air-conduction audiogram of the left ear taken just before mobilization. The broken line shows the air-conduction audiogram of the same ear 13 months after mobilization of the stapes. The preoperative bone conduction is also shown. Speech-reception threshold: before mobilization, 55 db.; 13 months after mobilization, 20 db.

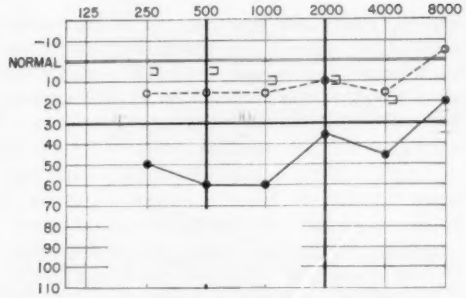

Fig. 13 (Case 8, P. K.)—The solid line indicates the air-conduction audiogram of the right ear taken just before mobilization of the stapes. The broken line shows the air-conduction audiogram of the same ear 12½ months after mobilization. The preoperative bone conduction is also shown. Speech-reception threshold: before mobilization, 60 db.; 12½ months after mobilization, 20 db.

a speech-reception threshold of 55 db., a discrimination score of 100%, and full tolerance for loud sounds. On April 7, 1953, the stapes was found to be rigid, but manipulation mobilized it, with immediate improvement of hearing on the operating table. At the end of 13 months her average loss for pure tones was 20 db., with a speech-reception threshold of 20 db. (Fig. 12).

Case 8.—P. K., a woman of 33 with bilateral progressive deafness for five years, had an average

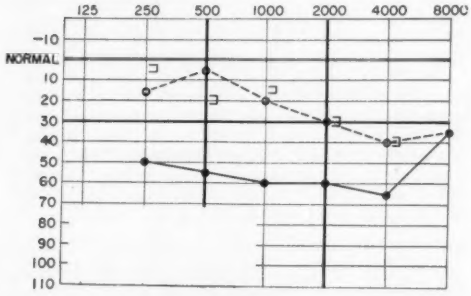

Fig. 14 (Case 9, E. D.).—The solid line indicates the air-conduction audiogram of the right ear taken just before mobilization. The broken line indicates the air-conduction audiogram of the same ear seven months after mobilization of the stapes.. The preoperative bone conduction is also shown. Speech-reception threshold: before mobilization, 60 db.; seven months after mobilization, 15 db.

pure-tone loss in the right ear of 53 db., a speech-reception threshold of 60 db., a discrimination score of 98%, and full tolerance for loud sounds. On April 14, 1953, the rigid stapes of the right ear was mobilized. Hearing tests performed several days later seemed to indicate little improvement in hearing. Suppuration in the middle ear occurred, which healed in 4 to 5 weeks. After this, her hearing improved to a pure-tone average of 13 db. and a speech-reception threshold of 20 db. (Fig. 13).

Case 9.—E. D., a housewife, aged 40, with a history of bilateral progressive deafness for 10 years. The preoperative average loss for pure tones in the right ear was 58 db., with a discrimination score of 100% and full tolerance for loud sounds. The

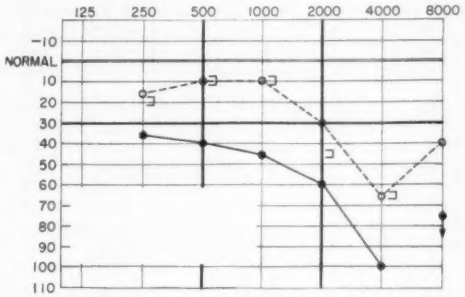

Fig. 15 (Case 10, H. K.).—The solid line indicates the air-conduction audiogram of the right ear taken just before mobilization. The broken line shows the air-conduction audiogram of the same ear six months after mobilization. The preoperative bone conduction is also known. Speech-reception threshold: before mobilization, 45 db.; six months after mobilization, 15 db.

contour of the bone audiogram indicated some inner-ear involvement in a predominantly conductive deafness. On Sept. 24, 1953, the stapes was found to be rigidly fixed but yielded to manipulation, with immediate improvement in hearing. At the end of seven months the average loss for pure tones was 18 db., with a speech-reception threshold of 15 db. (Fig. 14).

Case 10.—H. K., a man of 39, with a history of bilateral progressive deafness for 18 years. He had

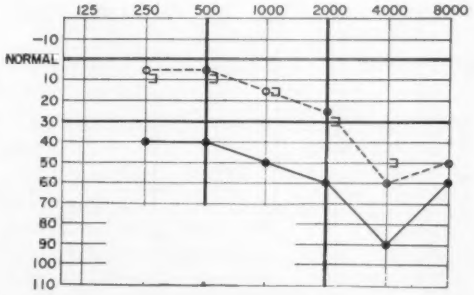

Fig. 16 (Case 11, L. S.).—The solid line indicates the air-conduction audiogram of the left ear taken just before mobilization. The broken line shows the air-conduction audiogram of the same ear four months after mobilization of the stapes. The preoperative bone conduction is also shown. Speech-reception threshold: before mobilization, 50 db.; four months after mobilization, 15 db.

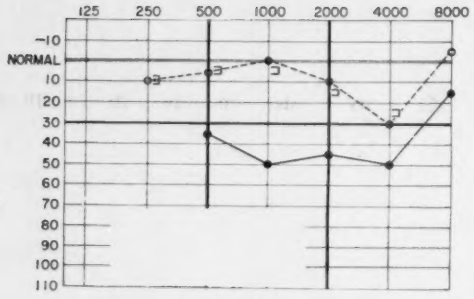

Fig. 17 (Case 12, G. H.).—The solid line indicates the air-conduction audiogram of the right ear taken just before mobilization. The broken line shows the air-conduction audiogram of the same ear four and one-half months after mobilization of the stapes. The preoperative bone conduction is also shown. Speech-reception threshold four and one-half months after mobilization was 15 db.

worn a hearing aid for 10 years. The average loss for pure tones in the right ear before mobilization was 48 db., with a speech-reception threshold of 45 db. and a discrimination score of 96%. The air-bone relationship indicated a mixed, predominantly conductive-type deafness. After mobilization of the stapes, on Oct. 16, 1953, the patient discarded his hearing aid and at the time of writing was enjoying hearing of 17 db. for pure tones and a 15-db. speech-reception threshold (Fig. 15).

Case 11.—L. S., a man of 53, with progressive bilateral deafness for 10 years, had worn a hearing aid successfully for 6 years. Pure-tone bone and air audiometry indicated a mixed, predominantly conductive deafness bilaterally, with a speech-reception threshold of 50 db. in the left ear, and with discrimination scores of 98% and full tolerance to loud sounds in each ear. On Jan. 11, 1954, his

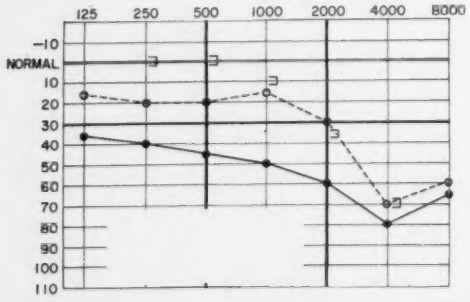

Fig. 18 (Case 13, N. B.).—The solid line indicates the air-conduction audiogram of the left ear taken just before mobilization. The broken line shows the air-conduction audiogram of the same ear two months after mobilization of the stapes. The preoperative bone conduction is also shown. Speech-reception threshold: before mobilization, 55 db.; two months after mobilization, 25 db.

rigid left stapes was mobilized. It is interesting to note that, despite the similarity of contours of the premobilization and postmobilization audiograms, the patient benefited sufficiently in the speech range (500 to 2000 cps) to enjoy a speech-reception threshold of 15 db. (Fig. 16).

Case 12.—G. H., a housewife, 41 years old, reported a history of bilateral progressive deafness for over eight years. She had worn a hearing aid occasionally during the past four years. There was a history of deafness in her maternal family. Audiometry performed prior to mobilization of the right stapes showed an average pure-tone loss of 43 db. On Dec. 3, 1953, the right stapes was found to be rigidly fixed and was mobilized. Her hearing four and one-half months following mobilization of the fixed footplate of the stapes was within normal audiometric limits of hearing, with an average pure-tone loss of 5 db. and a speech-reception threshold of 15 db. (Fig. 17).

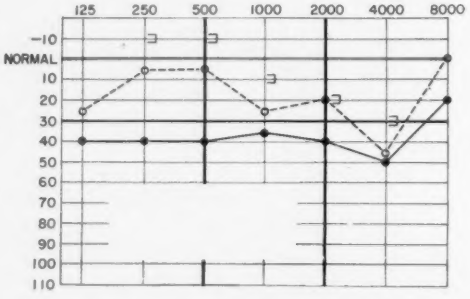

Fig. 19 (Case 14, B. G.).—The solid line indicates the air-conduction audiogram of the left ear taken before mobilization. The broken line indicates the air-conduction audiogram of the same ear six months after mobilization of the stapes. The preoperative bone conduction is also shown. Speech-reception threshold: before mobilization, 45 db.; six months after mobilization, 20 db.

Case 13.—N. B., a housewife, aged 40, had bilateral progressive deafness for 16 years. She had a left simple mastoidectomy in 1935. There was a history of family deafness. Pure-tone bone and air audiometry revealed a mixed, predominantly conductive deafness bilaterally, with a speech-reception threshold of 55 db., a discrimination score of 90%, and full tolerance for loud sounds in the left ear, which was selected for mobilization. After mobilization of the fixed stapes, on Feb. 18, 1954, her hearing continued to improve to an average pure-tone loss of 22 db., with a speech-reception threshold of 25 db. (Fig. 18).

Case 14.—B. G., a 38-year-old physician, with a history of progressive bilateral deafness for 10 years, had worn a hearing aid successfully for several years. Preoperative hearing tests on the left

ear revealed a predominantly conductive-type deafness with some inner-ear involvement, with an average pure-tone loss of 38 db. and a speech-reception threshold of 45 db. His average loss for pure tones six months following mobilization of the rigid stapes, on Oct. 21, 1953, was 17 db., with a speech-reception threshold of 20 db. (Fig. 19).

COMMENT

Audiologic findings presented here show that patients whose hearing improved after mobilization of the fixed footplate of the stapes have maintained their improved hearing for periods up to 26 months.

A study of the cases in which the attempt to mobilize the footplate did not result in improved hearing suggests the following possible explanations: 1. An extreme degree of fixation of the footplate which does not yield. Up to the present, this circumstance has not been encountered often. 2. Thin and fragile crura which fracture (sometimes audibly) under the force required to mobilize the footplate. 3. Faulty technique. If the direction of the force against the neck of the stapes is not in line with the crura, the latter may fracture. Likewise, if the force is mistakenly applied to the crus, which is thin, instead of the neck, which is thick, the crus may fracture. Failures due to faulty technique are diminishing as skill and instruments are improved. 4. Still unknown factors.

If for the above reasons hearing does not improve, fenestration can be performed without penalty.

In view of the relative simplicity of this procedure, cases such as Case 4, Y. R., reported above, may now be selected for mobilization to restore utilizable hearing. In Case 4 the benefit from the use of a hearing aid before mobilization was minimal and unsatisfactory. After mobilization the patient's improved hearing permits him to utilize satisfactorily any number of current hearing aids for the continued stimulation and preservation of his auditory imagery.

Two groups of otosclerotic patients appear to benefit by mobilization of the stapes: first, those with pure conductive or mixed-type deafness in which the cochlear potential, as measured by bone conduction, holds promise for socially usable hearing without a hearing aid, and, second, those with mixed deafness in which reversal of the conductive factor allows more efficient aided hearing.

The data at hand do not include a sufficient number of cases of one year's duration following mobilization of the stapes to warrant a detailed statistical presentation. A follow-up report will be made when such data become available.

SUMMARY

A new technique and special instruments for restoration of socially useful, unaided hearing in otosclerotic deafness are presented.

Audiologic evidence indicates that hearing improvement following mobilization of the footplate of the stapes has already been maintained for periods up to two years.

101 E. 73rd St.

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REVISION OF THE MIOT TECHNIQUE IN MOBILIZATION OF THE OSSICLE SYSTEM

Its Otoneurologic and Acoustic Basis

DANIEL E. SCHNEIDER, M.D., New York

BRIEF HISTORICAL SURVEY

RECENTLY Rosen[1] has become an active proponent of the mobilization of the stapes. Adequately informed and prepared otologists (and I, from my studies in otoneurology) know, however, that mobilization of the stapes occupies the largest place—next to fenestration—in the history of the surgery of deafness.

Mobilization of the stapes began with Kessel, in 1876, who first advised it, and extended his attempts even to extraction of the stapes and to excision of the annular ligament, with success. Mobilization of the stapes with variations was practiced by Schwartze, Michel, Urbantschitsch, and Boucheron. In 1890 the technique was brought to a very high state of development by Camille Miot.[2]

Rosen's description of his current procedure runs quite parallel to Miot's description of the technique of 1890. Rosen's apparent new technique adds little new. Miot's results were much more dramatic: 74 good results in 126 cases. Boucheron, in the discussion of Moure's paper on the subject, stated that it was possible to quadruple a patient's hearing by this method. Boucheron hailed mobilization of the stapes as "our operation of the future." Miot had repeated the mobilization on certain cases, stressed that the best results were obtained in cases of beginning ankylosis, set up various clinical categories of indication, and stated that the operation was useless in complete ankylosis of the stapes.

And yet, in spite of this dramatic beginning, by 1900, after a decade of its exploitation, mobilization of the stapes was abandoned. By 1900, Siebenmann * wrote:

> All endeavors at mobilization of the stapes are not only useless but often harmful. The fixation of the stapes in cases of progressive spongiosity takes place by the ossification of the periosteum.

The history of fenestration then began, culminating in the highly developed Lempert technique.

ORIGIN OF A NEW THEORY

This observation of Siebenmann stimulated me many years ago to begin the formation of a new theory of hearing whose surgical goal was the revival with revision of the Miot technique, including what will be called below the Holmgren maneuver. This new theory appeared from 1946 to 1949 in the *Journal of Nervous and Mental Disease* and in my monograph,[4] which received favorable mention in the A. M. A. ARCHIVES OF OTOLARYNGOLOGY as one of the most interesting papers of the year in which it appeared.

The points which otologic history raises are simply these:

A. If the stapes can be mobilized, can it—by some additional surgical and medical factor or factors—be kept mobilized?

B. Was it possible that the "progressive spongiosity" noted by Siebenmann was the result of a vegetative trophic neuritis?

C. Was there another and older sonic component in the hearing system of man which, under certain conditions, could bring the vibrating ossicle to a halt—say, by a disturbed trophic influence on the annular

Specialist certified by American Board of Psychiatry and Neurology.

* Reference 3. Bibliography, p. 681; references, p. 576.

ligament of the stapes, especially since the nerve supply to the vibrating ossicle system and its synergizing muscles is part of an old sonic system, just as the ossicles themselves derive from the old branchial arches; and could the same trophic disturbance via the geniculate ganglion produce at the same time pathologic irritability of the labyrinth?

The Miot technique had failed in the long run and the calm view. There was, therefore, no point in simply repeating the Miot technique, as Rosen has done, according to his apparent published description. One would simply be exploring and exploiting the same highway once more and come to the same dead end.†

If the Miot technique was to be revived, it was also to be revised.

ROSEN'S USE OF THE NEW THEORY

It is by now well known how often Rosen has in the past quoted my since-evolved theory of a dual hearing system in man. This theory stated simply that in higher mammals there are two hearing systems which became fused: 1. In man the most highly developed cochlea in relationship to the most highly developed labyrinth became differentiated for the perception of external sound and of human speech. 2. A primitive sonic system controlling the vibrating ossicles via the tympanic plexus and its associated important ganglia could conceivably influence the labyrinth via the geniculate ganglion and the nervous intermedius. Disease of this more primitive system was held responsible for tinnitus and vertigo. (Recent work by L. Balamuth and me [5] on the pattern of human perception of subultrasonic sound goes a long way to prove the existence and role of this primitive sonic system in the etiology of tinnitus and vertigo.) In a normal hearing system the external sound and speech perceived by the more highly evolved system dominates the more primitive internal sound system, which is normally silent and not tinnitic or vertigogenic. Or, in other words, in normal hearing the vibrating ossicle system, labyrinth, and cochlea are supported, not impeded, by the more primitive sonic system represented in part by the tympanic plexus.

Furthermore, in 1949, my theoretical work led to the following published tentative thesis [4]:

> Otosclerosis, pathologically and physiologically, is a neuritis, a trophic disease of the oval window leading to stapes ankylosis; the tinnitus is apt to be inconstant, the vertigo slight. The tympanic plexus is the major site of the disease process.

In his various publications attempting to justify his section of the chorda tympani, Rosen relied heavily on this theory and quoted it repeatedly, but not relevantly, in his claim that he cured a diseased labyrinth by a section of the chorda. In various publications ‡ I have tried to correct the impression that my theory in any way sanctions the section of the chorda tympani, or the rather puzzling claim that there is "no taste" in the chorda tympani, or the proceeding as though the chorda tympani were an expendable nerve.

DEVELOPMENT OF THE REVISED TECHNIQUE OF MIOT

A. The First Element: Section of the Nerve of Jacobson and the Petrosal Branches (Tympanic Plexectomy).—One of the goals in the revision of the Miot technique flowed naturally from my theoretical orientation. The tympanic plexus was to be stripped once mobilization had been secured, particularly the major nerve, the nerve of Jacobson and the petrosal branches, which is especially trophic to the stapes, the annular ligament, and the surrounding bone—that very bone which became, as Siebenmann showed, the site of a "progressive spongiosity."

And, after mobilization of the stapes, it is a simple thing to obliterate the nerve of Jacobson in the same surgical field in which the ossicle system is exposed for mobilization. In the hands of an experienced operator, it requires but a tiny movement of the

† In his most recent report (New York State Journal of Medicine **55**:69 [Jan. 1] 1955), Rosen again fails to record Miot's work.

‡ Reference 6, footnote p. 162. Reference 7, footnote p. 496.

probe to interrupt the nerve of Jacobson and other accessible branches after mobilization is completed, just before the drum is put back. This brought a possible new factor to the revival of the Miot technique, and if tympanic plexectomy proved effective under this new special condition of mobilization, it might justify the revival of Miot's work.

This suggestion is now all the more cogent, since a series of cases done by a surgeon instructed in the "Rosen technique," as publicly described and as apparently demonstrated by Rosen, had very indifferent results, namely, only 2 cases of improvement out of 10, a much smaller percentage than that of the abandoned Miot technique.§ As for Rosen's results publicly claiming durability in one case of at least two years, assuming that this is not a case of hysterical deafness, it is difficult to explain them by a simple repetition of Miot's technique, unless the otosclerotic process has become less rampant in the 64 years which have passed since the days of Miot and Boucheron, or unless otosclerosis on the American continent is meeker than it was in the France of the 1890's. I do not believe that antibiotics make the difference. There is a chance that the incision might, if healing puts traction on the ossicle system in certain cases in such a way that the annular ligament can not pull the stapes close to the invasive bone. This, too, seems unlikely.

Rather, it would seem that the results Miot obtained, namely, 74 good results out of 126 operative cases, instead indicated the operation of a basic sonic principle, which had become pathologically blocked; hence, my attraction for the past 10 years to the tympanic plexus, which contains the trophic nerve supply not only to the stapes but to the area of bone involved. The tympanic plexus also includes, as is known, important branches from the superficial petrosal nerves. Several years ago at the Blumenthal Auditorium at the Mount Sinai Hospital, at the specific request of Rosen, who presented some of his cases of chorda tympani section, I discussed this phase of the problem with reference to his case histories and patients that I had seen.

B. The Second Element: Rotation of the Stapes (the Holmgren Maneuver).—The second reason for revival and revision of the Miot technique was that Miot had exerted force on the ossicular system only in the direction perpendicular to the line of ossicular movement, i. e., he attempted by essentially a backward and downward pull in the neighborhood of the incudostapedial articulation to "break" the ankylosis. In Miot's technique the apparently fixed stapes could not be pushed forward. It had to be pulled backward in the direction of the stapedial tendon. In the normal case it is possible to push the stapes forward, but in 1890, and still today, it is not possible to do so; there was, and is, a very profound reason for this fact. Miot could not have known an important accidental observation Holmgren was destined to make 33 years later, and one which is important even today.

In 1923 Holmgren [8] reported four cases of otosclerosis in the early history of his work on fenestration. In one unusual case he accidentally twisted the stapes in such a way that the oval window was opened and fluid exuded from the labyrinth. An immediate hearing test was made and showed an obvious improvement in hearing.

A careful analysis of this phenomenon shows that in all likelihood it could not have been due solely to the exuding of labyrinthine fluid, i. e., to the simple decompressive factor, but rather to the rotation of the stapes. In order to appreciate the possibilities of this fact, it is necessary to note two elementary facts in the science of acoustics.

The first is that sound itself as a physical phenomenon is a periodic force producing an asymmetric bombardment. The second fact follows from the first; in an oscillating acoustic system having nonrigid connections, torsion, that is, rotation of an end-plate, is produced by that asymmetric bombardment.

In brief, the stapes normally does not simply move "back and forth"; it also moves, being the end-plate of an oscillating acoustic

§ Personal communication to the author.

system having nonrigid connections, in a rotary fashion, and one of the synergistic functions of the stapedius muscle is to correct or balance that tendency to rotation depending upon the stimulus and other factors. The relationship of the stapedial tendon to the movement of the stapes thus is critical. If the capacity of the stapedius muscle to correct or balance the rotary movement is overcome, fixation or other disturbances must result. This explains why disease of the geniculate ganglion, through which the nerve of supply to the stapes runs, or from which it originates, may cause sudden deafness. The stapedius muscle may be thrown either into spasm or into paralysis, with resulting interference in stapes function due to loss of the counterbalancing effect of the stapedius muscle. Taken together with disease of the tympanic plexus and the petrosal ganglion, it can be seen that the entire syndrome of deafness, tinnitus, and vertigo is in all likelihood entirely neuritic. The "progressive spongiosity" of Siebenmann may thus itself be a symptom of a vast trophic disturbance. Or, in other words, a stapes may be considered to be truly mobilized not when it simply is made to go "back and forth" but when it primarily is capable of a rotary reaction to that periodic asymmetric bombardment which is the phenomenon of sound.

The second experimental element then in a revived and revised Miot technique was to attempt essentially to free the stapes for rotary motion if possible, and this we have named the Holmgren maneuver after its first observer.

Neither in his first communication nor in his demonstrations at the operating table (four of which I recently witnessed in person in the presence of otologists attending the American Academy at Mount Sinai Hospital) does Rosen specifically describe

1. Miot's original technique.

2. The stripping of that portion of the internal sonic system represented by the tympanic plexus, particularly the nerve of Jacobson, which is trophic to the stapes and the petrosal branches.

3. The Holmgren maneuver described above.

These historical considerations—and practical differences from the technique that Rosen describes—are outlined in this brief communication at the present time, prior to another series of mobilizations.

All these theoretical otoneurologic and acoustic observations, part of my own long-standing research program, are presented at this time because so many otologists will now be practicing, whether they know it or not, the Miot technique which Rosen has apparently simply repeated. I should like to suggest that no harm whatever can be done by trying to strip the tympanic plexus simply by interrupting the nerve of Jacobson and the petrosal branches and at the same time by trying to achieve with great caution a small rotation of the stapes. This would at least have rational otoneurologic and acoustic meaning. However, to achieve rotary freedom of the stapes is not a simple matter, and it will ultimately require special surgical devices, which are now in the process of being designed. Until then, great caution must be observed, since, as Holmgren reported, it is possible to dislocate the stapes.

This paper is also written further to inform the otologic profession of the history of these new theoretical and practical developments and to acquaint the otosurgeon with the new possibilities which arise from a new otoneurologic theory.

SUMMARY

The Rosen procedure as apparently described and as apparently demonstrated is simply an unrecognized repetition of the essential Miot technique.

Miot's results were even more dramatic than Rosen's, and, yet, after a decade of its exploitation, the Miot technique was abandoned, as was mobilization of the stapes in general, whatever variation was practiced. Yet, Miot's results indicate the operation of a basic sonic principle pathologically blocked.

My own theory of a dual hearing system begins at this point. This point takes as its surgical goal the freeing of the ossicle system from disease of the old sonic system con-

tained in the tympanic plexus and, especially, in the nerve of Jacobson. In this way external sound can again dominate internal sound. Similarly, this theory takes as its goal the prevention, if necessary the surgical prevention, of ankylosis of the stapes in beginning deafness. The problems of prophylaxis will be discussed in a separate study.

The two new elements tentatively added in the experimental revival and revision of the Miot technique have for their goal, first, the freeing of the stapes from possible trophic disturbances arising in the tympanic plexus and conveyed by the nerve of Jacobson and the petrosal branches, and, second, the restoration of the rotary acoustic aspects of stapedial action, which involves also the function of the stapedius muscle. The mobilization of the stapes is essentially free rotary movement in combination with oscillation perpendicular to the plane of the stapedial footplate.

The apparently described and apparently demonstrated Rosen technique, in other hands, produces only 2 satisfactory results out of 10. The two may still be only temporary improvements. A new series using the Miot-Holmgren technique, with interruption of the nerve of Jacobson and the petrosal branches, is to be tried and will be reported. Special surgical devices to achieve rotary freedom of the stapes are being planned.

It should be added, in summary, that the logical necessity in view of only a 20% result is, of course, the necessity to differentiate before operation a mobilizable from an irreversibly fixed stapes. The latter group can only be treated by fenestration. Only in this way can many deafened persons avoid needless and futile surgery, including the danger of broken crura and torn chordae tympani. I do not agree with Rosen's statement that the chorda tympani is an expendable nerve; salivation and taste are important functions. A surgery of deafness can now be evolved which need not injure any important structures. An attack upon the problem of differential diagnosis will be presented in another communication.

61 E. 93rd St.

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SOME OBSERVATIONS ON BRAIN ABSCESS

E. A. STUART, M.D., Montreal, Canada
F. H. O'BRIEN, M.D., Waterbury, Conn.
and
W. J. McNALLY, M.D., Montreal, Canada

THIS REPORT is based upon a study of the case records of a series of 125 patients having pyogenic abscess of the brain which was verified either by operation or postmortem examination at the Royal Victoria Hospital and the Montreal Neurological Institute over a 25-year period (1925-1950).* The treatment had been carried out by various members of the staffs of these two hospitals. We are much indebted to them for the use of this material.

We propose to make certain observations on these infections and their relationship to the sources from which they were apparently derived.

SITES OF DISSEMINATION RESULTING IN BRAIN ABSCESS

Eighty-five of the series were considered to be derived from loci of infection proximate to the brain; 18, from remote loci, and 22, from sources unknown.

PROXIMATE LOCI OF INFECTION RESULTING IN BRAIN ABSCESS

It is evident (Table 1) that most of the intracranial abscesses of this series occurred as complications of infections near the brain. These were derived from sources of suppuration about the head, especially from infections of the middle ear and paranasal sinuses (Table 2).

A. Relationship of Otitis Media and Mastoiditis to Intracranial Abscess.—In our study, the commonest source of all infections leading to abscess of the brain was otitis media with mastoiditis. Indeed, almost half of all of the instances of brain abscess were due to infectious disease of the middle ear.

For the most part, the infections spread to the cerebral hemispheres rather than to the cerebellum, intracerebral abscess being twice as frequent as intracerebellar abscess (Table 3).

It is generally agreed that intracranial abscess, particularly cerebellar abscess, more often follows as a complication of chronic rather than of acute infectious disease of the middle ear. This was our experience as well. Twice as many instances of abscess of the brain occurred as a result of chronic suppuration in the middle ear than occurred in those with acute suppuration (Table 4).

During the period included in the study, 4750 acute middle ear infections were treated in hospital: of these, only 22 developed intracranial suppuration, about 0.5%. In the same time, approximately 1400 cases of chronic middle ear infection were treated in hospital, and of these 39 developed abscess of the brain, about 3%.

B. Otogenous Intracerebral Abscess.—We found that when intracerebral suppuration supervened in the course of middle ear infection it was almost always located within that part of the brain contiguous with the site of primary infection, usually the temporal lobe, either alone or in combination with adjacent cerebral subdivisions.

Of the 41 intracerebral abscesses of otogenic origin, the infection was bilateral in 4 cases. For this reason it was not possible

From the Royal Victoria Hospital and the Montreal Neurological Institute.

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* It does not include those in which brain abscesses occurred as a complication of skull fracture, penetrating wound of the head, or infection after craniotomy.

TABLE 1.—*Disseminating Sites of Infection in Brain Abscess*

	Cases, No.
Proximate loci	85
Remote loci	18
Unknown	22
Total	125

to say that these abscesses were contiguous, but they could have been, because in all 4 there was an abscess in a temporal lobe. (One was complicated by an additional abscess in the ipsilateral frontal lobe.) In two instances of unilateral otogenic infection, the cerebral abscesses were found in the contralateral hemisphere in the parietal lobes.

These exceptions to the commoner behavior of dissemination, while infrequent, deserve emphasis.

C. Otogenous Intracerebellar Abscess.—In this series there were 20 instances of intracerebellar abscess. All of these were otogenous and ipsilateral with the infected ear. A significant number of these showed manifest continuity of infection from source to secondary site of suppuration in the cerebellum. Thus, three showed the presence of pus in direct extension from the ear to the

TABLE 2.—*Proximate Loci of Infection*

	Cases, No.
Otitis media and mastoiditis	61
Paranasal sinusitis	20
Osteomyelitis of skull and infection of related soft parts	4
Total	85

affected cerebellar lobe, and one showed pus in the internal auditory canal and in the sheath of the eighth nerve.

D. Relationship of Paranasal Sinusitis to Intracranial Abscess.—As shown in Table 2, there were 20 intracranial abscesses complicating paranasal sinus infections.

In all of these the primary infection was acute, occurring either as a single episode of acute suppuration or as an acute exacerbation of an infection considered to have been chronic.

This presents an interesting comparison with those cases of intracranial abscess derived from infections of the middle ear when the opposite of this sequence obtained (Table 4).

Fulminating and extensive infections such as acute paranasal pansinusitis and osteomyelitis were the commonest sources of intracranial abscess in this group.

Moreover, the dissemination appeared to be derived most frequently from the frontal sinus: in 18 of the 20 cases the frontal sinus

TABLE 3.—*Intracranial Suppuration from Otitis Media and Mastoiditis*

	Cases, No.
Intracerebral abscess	41
Intracerebellar abscess	20
Total	61

was included. The sphenoidal sinus was held responsible in one case, and the sphenoidal and ethmoidal sinuses together, in another.

The relationship of the infected region of the brain to the disseminating locus of infection seemed clearly to be contiguous. In every instance in which frontal sinusitis was followed by brain abscess, the frontal lobe was always involved, although adjacent cerebral territories were sometimes included. Relatively remote regions, such as temporal, parietal, or occipital lobes, were not independently affected.

In the one case of sphenoidal and ethmoidal sinusitis an occipitoparietal abscess followed, which also, by continuity, involved the brain stem.

The only exception to contiguous spread in this group occurred in a single situation.

TABLE 4.—*Significance of Acute and Chronic Otitis Media in Intracranial Abscess*

Disseminating Locus	Total Cases, No.	Intracranial Abscess	
		Intracerebral	Intracerebellar
Otitis media acute	22	17	5
Otitis media chronic	39	24	15
Total	61	41	20

in which the primary site of infection was found in the sphenoidal sinus and the secondary site in the contralateral occipital and parietal lobes of the brain.

During the period included in this study, 350 patients hospitalized for acute paranasal sinusitis (excluding maxillary sinusitis) were observed, and of these the course of 20 was complicated by the occurrence of brain abscess. This seems to us a significant number and would appear to represent a more serious outlook than that which obtains in acute infections of the middle ear.

We emphasize that, during the period of the study, over 5% of patients hospitalized for treatment of acute frontal sinusitis developed intracranial abscess.†

E. Osteomyelitis of Skull and Soft Part Infection in Relation to Intracranial Abscess.—Four patients having infections of soft parts about the head developed abscess of the brain. In three of these cases there was osteomyelitis of the skull and subsequent abscess within the brain at a site immediately contiguous to the locus of the original and overlying infection.

In the one exception cerebral abscess followed nasal furunculosis, and in this the ipsilateral frontal lobe was involved. While the pathway of spread may have been by way of the tributaries of the cavernous sinus and the cavernous sinus itself, this was not established nor was any other route at once evident in the autopsy material.

REMOTE LOCI OF INFECTION RESULTING IN BRAIN ABSCESS

Of the total series of 125 cases, 18 instances of intracranial abscess were considered to have been disseminated from remote loci and by vascular metastases. All of these were supratentorial. The commonest source of remote dissemination was the lung. In 15 of the 18 cases, because of preceding suppuration in the lung and the presence of organisms common to the cerebral and pulmonary lesions, the diagnosis seemed reasonably founded.

Cerebral abscess occurred in the course of hematogenous osteomyelitis in two instances and in the presence of severe acne in one other. In the latter, Staphlococcus pyogenes was obtained from the skin pustules and from the cerebral abscesses alike. It seemed most probable that the brain abscess had developed in the course of a transient staphlococcal bacteremia.

In all 18 cases the sites of abscess in the brain were in the cerebrum; all were deep in the hemisphere and in the frontal, temporal, parietal, and occipital lobes, usually in combination; all were in the distribution of the middle cerebral artery. Only one was bilateral in the brain, but for the most part they were multiple in one hemisphere.

The singular escape of the cerebellum and the brain stem is interesting and has been remarked by others.[3] It suggests that the route of metastases is oftenest by the carotid circulation.

BRAIN ABSCESS OF UNKNOWN SOURCE

In the series there were 22 cases in which the exact site of dissemination was in doubt. It is significant that, in this group, six were under strong suspicion of primary pulmonary lesions as in preceding pneumonia. One may have been the result of spread either from otitis media or parotitis. One probably originated in frontal sinusitis. One may have arisen from a urinary tract infection, and two may have followed infection in the oral cavity associated with abscessed teeth.

In this group of cerebral abscesses, considered to be metastatic, we have found that they occurred characteristically as multiple suppurations throughout the brain.

COMMENT

A. Intracranial Abscess.—The results of this study emphasize again the significance of infections of the ears and paranasal sinuses as the commonest primary sources of intracranial abscess.

† This figure may be unusually high because many cases of brain abscess are referred to the Montreal Neurological Institute from other hospitals.

One should be on the alert for signs of this complication. Supervening meningitis is frequent, though not always present, as an accompaniment or a precursor to brain abscess. Of the 105 cases of cerebral abscess, meningitis occurred in 23. Of the 61 cases in which the primary locus was in the ears or paranasal sinuses, meningitis was present in 18. It occurred five times in association with cerebellar abscess.

Oculomotor palsies, papilledema, aphasia, stupor, monoparesis or hemiparesis, and defects of visual fields strongly suggest intracranial suppuration.

Convulsions, generalized or focal, are important indications of abscess above the tentorium.

Rapidly increasing signs of intracranial pressure are often the first signs of cerebellar abscess. In addition, pointing errors, gross hemiataxia, or dysmetria of one limb may occur as indicative signs of cerebellar involvement. Coarse horizontal nystagmus on gaze to one side may indicate that the lesion is restricted to that cerebellar hemisphere. However, this is a variable sign, as stated by Fraser [5]: "At one time it is directed to the affected side and at another to the sound side, or it may be absent for short periods." Vertical nystagmus almost always is significant of disease in the brain stem.[7]

We found only one case of coexisting cerebellar and temporal lobe abscess, but the possibility of simultaneous supratentorial and infratentorial spread of middle ear infection deserves to be kept in mind.

B. Cerebral Cortical Venous Thrombosis.—There are other instances when certain supervening signs of cerebral involvement, in the course of infections of the ears and paranasal sinuses, occur but in which the suspected abscess fails to be demonstrated and the clinical course reverses toward recovery.

The signs of such cerebral involvement are curiously characteristic and consist in seizures, chiefly involving face and arm; hemiparesis, especially involving the same parts; aphasia, if the dominant hemisphere is affected, and signs of meningeal irritation.

We believe the explanation for these phenomena, in the absence of intracranial abscess, which they so alarmingly simulate, may be due to cerebral venous thrombosis or thrombophlebitis.[9]

In this connection, it is generally conceded that the spread of ear and paranasal sinus infections to the brain is by way of venous channels.‡ This route of extension would seem to explain also the escape of intervening structures immediately contiguous to the primary locus, viz., the fluid of the subdural space and the cortex of the brain.

In our own study, manifest continuity of infection as in direct, continuous, purulent extension from source to secondary site was only rarely found. The usual situation was an intact dura and subdural space, with uninflamed cortex but with abscess buried below in the subcortical white matter.

In our material we found four instances in which brain abscess was associated with evident thrombosis of major cortical veins.

We consider it likely that in some instances a cerebral venous thrombosis or thrombophlebitis may occur without further extension of infection and intracerebral suppuration. Such an event might well explain the condition we have referred to above, sometimes called pseudobrain abscess § or nonsuppurative encephalitis.[8]

In a previous paper we reported 16 cases of this sort, which we had collected during the same period covered in the present study. Three of these occurred in the last year of the study. Since then we have observed 10 others.

We suggest that this apparent increase of occurrence of cerebral venous thrombosis may be related to the advances of antibacterial therapy and that some infections were arrested in intermediate vascular stages which might otherwise have gone on to develop brain abscesses.

‡ References 2 and 4.

§ References 1 and 6.

CONCLUSIONS

1. Infection of the ears and paranasal sinuses is the commonest source of intracranial abscess, and otitis media is the most frequent single cause.

2. Chronic more often than acute otitis media and mastoiditis results in intracranial abscess.

3. Intracerebral abscess, as a complication of otitis media, is more frequent than intracerebellar abscess.

4. Intracerebellar abscess is almost invariably derived from primary infection in the middle ear.

5. Acute suppurative paranasal sinusitis with osteomyelitis is the second commonest source of intracerebral suppuration.

6. Infections of the lung are the most frequent sources of intracranial abscess derived from loci remote from the head.

7. Metastatic suppurations of the brain are frequently multiple and are almost invariably located above the tentorium.

8. The apparent increase of cases of cerebral venous thrombosis may indicate that in some patients antibacterial therapy has arrested the progress of infection which might otherwise have gone on to brain abscess.

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A PSYCHOLOGICAL AID IN THE DIAGNOSIS OF DEAFNESS OF EMOTIONAL ORIGIN

STEVEN B. GETZ, Ph.D., Berkeley, Calif.

ON THE basis of their audiograms, six boys were considered in need of the facilities of a school for the deaf.* However, on the basis of psychological investigation, each has been found to present problems, the solution of which could have more effectively been dealt with in other settings, i. e., they were not organically deaf.

Audiometric data on each of the six cases are listed in the Table. For each, it became clear that the primary disorder was not one of sensory impairment, but rather of a psychological disturbance, but there was the similarity, in all, of a hearing disorder expressing itself as a symptom of the psychologic disturbance.

Three cases illustrating different causal conditions for the defective response to audiometric testing are reviewed below.

REPORT OF CASES

CASE 1.—The psychologist's diagnosis of an autistic withdrawal state, confirmed in psychoanalytic treatment, explained the audiometric findings. This student was in diminished contact with environmental stimuli and responded only after the audiometer's stimulation was well above his normal threshold, had he not been so disturbed.

In the therapy preliminary to the psychoanalytic treatment, the intent of the psychologist was on the reestablishing of an interest in, and an ability for reacting to, environmental happenings. After several months of one-hour daily meetings, during which time finger painting and other expressive techniques were used along with auditory stimulation, it was considered that the student was ready for a modified psychoanalytic treatment, and referral was made.

Progress was noted by his teachers and house parents, and he achieved the Superintendent's List, which achievement is expressive of successful adaptation to the requirements of curricular and extracurricular living, whereas previous to psychological treatment he sat in his classroom, an obedient but slow and passive student. He can utilize his auditory sense more effectively, whereas before treatment he relied solely on lipreading, ignoring the attendant auditory stimuli.

CASE 2.—This student had been recently referred to this school from a public day school for the deaf, where he had been for eight years. On his records was the statement that he suffered from the following hearing loss: 78 right, 76 left. Psychological testing indicated a serious personality disturbance of a "psychopathic-like" nature, evidenced in a vacillating apathetic and casual attitude towards the fulfillment of the psychological test requirements.

Two months later there was evidenced still the underlying pathology, but an improved ability to deal with the test materials and his environment. While the initial testing had indicated mental deficiency, the later testing revealed a capacity for normal intellectual functioning. In this case it is felt that the improvement resulted from association with a teacher having the ability to relate to disturbed students in a sympathetic, yet firm, manner.

His acoustic disturbance, as indicated in audiometric testing, is understandable when viewed as a combination of an inability for focusing of attention on auditory stimuli and inability to react in a simple and straight-forward fashion to the requirements of the interpersonal audiometric situation.

CASE 3.—Psychological testing and follow-up interviews with this student indicated that he was a passive, schizoid person, who was not directly in contact with his environment, who "absorbed" potentially threatening stimuli into a passive, visually rich thought life. When tested with the audiometer and in the initial stages of auditory training, he reacted with extreme discomfort and complaint to the stimulation.

It was only later in treatment, after we had discussed his home situation, and through a chance happening, that his "reason" for his defective audiometric response became clear.

There had been, and still is, frightful discord in his family life. As a child he was subjected to violent and noisy scenes of marital disagreement. He had, it appeared, erected a barrier, a wall to

Psychologist-Audiologist, California School for the Deaf.

* This paper is based on the writer's experiences at the New York School for the Deaf.

"shut out" the threatening auditory stimuli. Since he had not, since then, developed satisfactory methods of relating to his environment, this defensive wall served to protect him.

At one meeting, where his behavior generally silly, evoked a reaction of chagrin in the psychologist, the psychologist, under the pressure of this annoyance, raised his voice in speaking the next word for auditory stimulation. The reaction of the student to this increased stimulation solved the problem. He reacted with discomfort, as he had to the normally spoken words, but this time he heard what had been said. It appeared as if the psychologist had penetrated the defensive wall.

Malmo, Davis, and Barza report a similar result in the treatment of a case of total hysterical deafness. In their experience the stimulus employed to penetrate the "symptom defense" was a pure tone at a 90-db. amplitude; while with this patient under discussion the therapist's voice was sufficient to achieve the therapeutic result.[1]

nonorganic deafness usually present behavior problems and learning problems more serious than those found in the deaf child. It is opinioned that it is the aberrant behavior of this group of persons that is responsible for the widespread concept of conditions of paranoia and other severe personality disorders associated with deafness in the public mind. It is probable, for example, that where extreme suspiciousness is found with impaired hearing the hearing impairment is, as is the suspiciousness, a defensive reaction against hostile and other self-unacceptable thoughts in a person with a normal hearing apparatus. Often to the school for the deaf will be referred a child who presents extreme problem behavior and language retardation, with the "findings" of the referring agency,

Audiometric Data on Students with Nonorganic Deafness Who Attended School for the Deaf

Student	Decibel Loss in Better Ear					Date of Birth	Date Admitted to School	Attendance at School, Yr.
	256	512	1024	2048	4096			
1.....	85	75	85	105	90	12/24/40	9/ 9/46	6½
2.....	58	85	80	65	65	12/ 3/41	9/ /44	8½
3.....	75	80	85	85	75	10/16/32	9/ 3/47	5½
4.....	70	80	80	80	80	8/16/43	9/13/48	4½ (discharged)
5.....	40	75	60	75	50	11/ 2/44	12/ 3/49	3
6.....	80	70	100	85	80	7/16/37	3/16/44	9

After several months of building the interpersonal foundation, and of ignoring the defensive protests, the student's silly behavior disappeared, and the student now perceives normally spoken words without discomfort.

AIDS TO DIAGNOSIS

The remaining three students presented similar problems in differential diagnosis. One point must be made clear: On the basis of audiometric response, inability to comprehend spoken language, and retarded language development, it did appear that the educational needs of the six students were similar to those of the organically deaf child, and it is understandable that in the absence of psychological testing, they were referred to, were admitted to, and remained at a school for the deaf.

With experience, two phenomena become associated with these "placement misfits."

Severe Interpersonal Malfunctioning.—The first phenomenon is that children with

that the problem behavior results from the condition of impaired language reception. While this diagnosis has validity in some cases, it is the result of a lack of thorough psychological examination in many others, with a ready desire to resolve the problem by passing it on. The possibility that both disturbances may reflect a problem in interpersonal living is not often mentioned in these reports.

The Draw-a-Person Test.—The second, and more consistent, phenomenon associated with this condition is a grossly disturbed drawing of a human figure when drawn to the simple request: "Draw a person," or "Draw a man."

K. Machover states[2]:

In the production of a drawing there emerges out of the individual's total experiential background a unique pattern of movement and idea. Its significance for personality stems from the fact there are processes of selection out of the infinite pool of

experience and imagery potentially available in combination with a dynamic organization of movement and percept.

In all the cases cited in this report, the personality malfunctioning, based as it is on a history of negative experiences, was unmistakably reflected in the drawings. And, in all cases in which the features of the drawing have pointed up the possibility of personality malfunctioning, such malfunctioning has been confirmed through extended psychological examination and treatment. The drawings by this group appeared usually as more bizarre and deviant than those drawn by disturbed deaf boys.

Drawing of Case 1: His drawing of a man was identical to that of a woman: both were stick figures with round heads, from the top of which a tassle of hair fell widely over round, pupil-less eyes, and a widely opened mouth held large destructive-appearing teeth. Reapplication of this test after periods of therapy revealed the reason for this simplified presentation. There was pictured a confusion between male and female. In his thinking both had become the simplest representation of the two figures he could imagine. Unfortunately, in order to suppress thinking in this area, his thought processes in general became simplified and repressed.

With time, and treatment, the drawings became more elaborate. Buttons appeared, as did the outline of a shirt and trousers, through which the trunk and legs could be seen. Psychoanalytic treatment was continued in the hope of greater improvement, since these lapses in judgment, reflected in the transparency, indicated that pathology remained.

Drawing of Case 2: At the later testing, the original drawing of a huge, badly placed head became more appropriate in position and size, consonant with a diminishing of his bizarre interpersonal behavior.

Drawing of Case 3: When asked to draw a figure, he proceeded to draw a landscape. In the distance was a small lake, in which he drew a small canoe, in which he placed two tiny duck hunters. As treatment progressed, his figures became larger, but he still had to elaborate and protect his figures with assorted environmental settings. His figures were always well drawn. The pathology expressed itself in his inability to meet the requirements of the testing situation (and life situations) directly, necessitating the rich, visual fantasy life.

RECOMMENDATIONS

In the investigation of this problem, the Draw-a-Person test has two strong recommendations. It requires no language for administration and performance. Secondly, it indicates unmistakably those students in need of further psychological study and treatment. Severe personality disturbance is obvious to those who have only the Machover (Draw-a-Person) test as a guide.

For these reasons, it is recommended that this test be used in addition to the standard audiometric procedures.

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STUDIES ON THE COMPOSITION OF AIR IN THE TYMPANIC CAVITY

HISASHI MATSUMURA, M.D., Okayama, Japan

COMPOSITION OF AIR IN THE TYMPANIC CAVITY OF PATIENTS WITH STENOSIS OF THE EUSTACHIAN TUBE

IF THE Eustachian tube remains closed, the air in the tympanic cavity gets gradually thinner, leading to retraction of the tympanic membrane.

Bezold interpreted this phenomenon to be precisely the same as respiration. He thought that the oxygen (O_2) content was absorbed from the surface of the tympanic cavity and that carbon dioxide (CO_2) was discharged in a minute amount. Koerner considered that the air was absorbed in its entirety. These interpretations, however, were not based on experimental results. The present study is concerned with microanalysis of the air of the tympanic cavity.

The experiment was carried out following Krogh's [1] method, with some modifications. The air of the tympanic cavity was aspirated, using a 2-cc. syringe (containing 6,9-diamino-2-ethoxyacridine [Rivanol]) with a long needle, through the tympanic membrane. As illustrated in the Figure, the main part of the analyzer is a capillary glass tube, 25 cm. in length and calibrated every millimeter. The air bubble obtained from the tympanic cavity was put into the analyzer. The CO_2 was absorbed into a 10% solution of caustic potassium and then O_2 into an alkalized solution of pyrogallol. In this way, the volumetric percentages of CO_2, O_2, and nitrogen (N_2) in the air sample were determined.

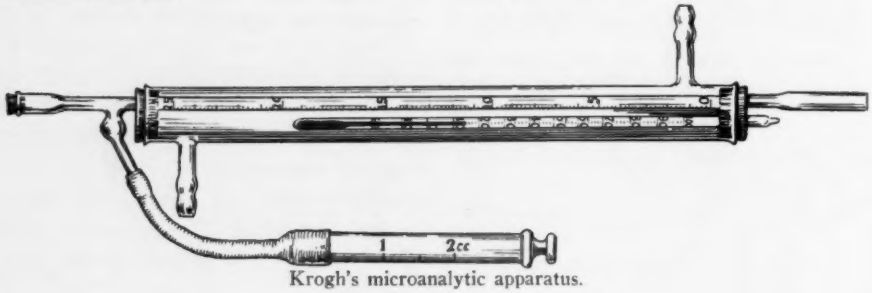
The analysis of the air of the tympanic cavity in 115 cases of stenosed Eustachian tube gave O_2 values varying between 9 and 15% (Table 1).

TABLE 1.—*Volumetric Percentage of Oxygen in Tympanic Cavity Air in Cases of Stenosed Eustachian Tube*

Percentage of O_2	No. of Cases
9.1-10.0	3
10.1-11.0	28
11.1-12.0	27
12.1-13.0	21
13.1-14.0	16
14.1-15.0	13
15.1-16.0	4
16.1-17.0	2
17.1-18.0	1
Total	115

In this experiment CO_2 was 0. Since O_2 in the air of the tympanic cavity of normal persons varied between 14 and 17%, as described later in this report, the experiment showed that the O_2 value in those with stenosed Eustachian tubes was much less than in the normal persons. Moreover, when the absorption of nitrogen is taken into account, the actual absorption of O_2 from the tympanic mucosa in those with stenosis of Eustachian tube may be considered to be more than represented by Table 1.

From the Department of Oto-Rhino-Laryngology (Director: Prof. S. Takahara), Okayama University Medical School.



Krogh's microanalytic apparatus.

Carbon dioxide was not revealed in the present experiment. But allowing for an experimental error of 1%, the possible presence of less than 1% CO_2 could not be ruled out. In incipient cases of acute suppurative otitis media, air in the tympanic cavity was surveyed for O_2 volume percentage, and this was found to be still less than in the cases of stenosed tube.

The tubal orifices of two cats were closed by means of electric cauterization, and the composition of the air in the tympanic cavity was surveyed. In one cat, after 12 hours, the O_2 volume was 9.4%, and in the other cat, after 25 hours, the O_2 volume was 10.0%. The air of the tympanic cavity was obtained by way of the bullae. This animal experiment gave approximately the same results as the experiment with the stenosis of the Eustachian tube in man.

COMPOSITION OF AIR IN THE TYMPANIC CAVITY OF NORMAL PERSONS AND OF PATIENTS WITH PATENT TUBES

Twenty-two persons with no history of middle-ear infection and with normal ear drums were selected for experiment. The O_2 value of the tympanic cavity varied between 14 and 17%. Since the O_2 percentage of the inspirated and expirated air is 21% and 17%, respectively, it is believed that O_2 is absorbed through the tympanic mucosa.

The air composition in the bullae of four ears, believed to be normal, of cats was surveyed. Their O_2 values were 12.8%, 14.5%, and 16.2%. Except for the first cat's one ear with tubal stenosis (discovered when the air passage of its Eustachian tube was examined with a manometer), the three other ears had air composition very similar to that of the tympanic cavity in normal man.

The composition of air in two patients with patent tubes and in another patient capable of voluntarily opening the Eustachian tube was surveyed. The O_2 values of the tympanic cavity in these three cases were 16.9%, 20.0%, and 16.8%, respectively. These were very near the O_2 value of the atmospheric air.

CHANGE IN THE AIR COMPOSITION OF THE TYMPANIC CAVITY AFTER CATHETERIZATION

In order to know how much ventilation would be given by means of tubal catheterization, the following two experiments were made.

Ten cases of stenosed Eustachian tube were selected. The O_2 volume percentage was first determined. The analysis of the air was made again after the negative air pressure of the tympanic cavity by the previous procedure returned to normal. And then final analysis was done after catheterization. As shown in Table 2, there was no noticeable difference in the composition of the air between the puncture of the tympanic membrane and catheterization.

TABLE 2.—*Readings of the Volumetric Percentage of Oxygen in the Tympanic Cavity*

Case, No.	Percentage of O_2		
	At First Determination	After Restoration from Negative Pressure	After Catheterization
1	10.7	13.0	15.0
2	11.6	12.9	*
3	12.2	16.0	*
4	12.5	14.8	16.0
5	12.7	15.9	15.1
6	12.9	18.9	18.9
7	12.9	15.2	19.0
8	13.3	*	15.0
9	13.4	16.3	19.1
10	14.5	*	16.9

* Analysis failed.

TABLE 3.—*Volumetric Percentage of Oxygen in the Tympanic Cavity After Catheterization*

Percentage of O_2	No. of Cases
9.1-10.0	1
10.1-11.0	0
11.1-12.0	2
12.1-13.0	3
13.1-14.0	10
14.1-15.0	6 *
15.1-16.0	3
16.1-17.0	2
17.1-18.0	2
18.1-19.0	3
Total	32

* Five normal persons are included in this group.

Five with normal tubes and 27 with stenosed Eustachian tubes were subjected to

catheterization. The air analysis was then made (Table 3). The results indicated that the catheterization failed to ventilate sufficiently for those with stenosis of the Eustachian tube.

CORRELATION BETWEEN THE TYMPANIC AIR COMPOSITION AND TUBE PATENCY, AND THE NEGATIVE PRESSURE OF THE TYMPANIC CAVITY

The grade of patency was measured by means of Valsalva's method and was shown in manometric pressure. Twenty-two cases were examined, regardless of a normal or stenosed tube. The analysis of the air in the tympanic cavity was done prior to the measuring of patency to avoid the influence upon the composition of tympanic air by Valsalva's method. As shown in Table 4, it was evident that the lower O_2 value was accompanied by poorer patency.

TABLE 4.—*Correlation Between the Air Composition in the Tympanic Cavity and the Patency of the Tube*

Case, No.	Percentage of O_2	Patency of Tube (Mm. Hg)
1	10.1	60
2	10.5	50
3	10.8	58
4	10.9	40
5	11.1	50
6	11.2	32
7	11.3	43
8	11.3	42
9	11.5	35
10	11.9	25
11	13.0	50
12	13.6	45
13	14.0	40
14	14.2	20
15	14.6	20
16	14.8	20
17	15.0	20
18	15.4	20
19	15.6	20
20	15.8	20
21	16.0	17
22	18.7	12

TABLE 5.—*Correlation Between the Air Composition and the Negative Pressure in the Tympanic Cavity*

Case, No.	Percentage of O_2	Negative Pressure (Mm. Hg)
1	9.4	—10.0
2	10.4	— 8.5
3	11.1	— 4.0
4	11.2	+ 6.0
5	11.5	— 8.0
6	12.2	— 4.0
7	13.1	—10.5
8	13.5	— 7.6
9	14.0	— 4.0

In the determination of the pressure in the tympanic cavity the Takahara-Tani [2] manometer was used. The results, given in Table 5, might suggest some correlation between the air composition and the negative pressure in the tympanic cavity.

SUMMARY

The studies on the composition of air in the tympanic cavity are reported.

The air taken from the tympanic cavity was analyzed by modified Krogh's method.

The O_2 volume percentage of 115 cases of stenosed Eustachian tube varied approximately between 9 and 15%. And these values were lower than those of 14 to 17% obtained from 22 normal persons.

The effect of catheterization upon the O_2 volume percentage of the tympanic cavity was not marked.

Close correlation between the O_2 percentage of the tympanic cavity and the patency of the Eustachian tube was noted.

The correlation between O_2 percentage and negative pressure in the tympanic cavity might be suggested.

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FOREIGN BODIES OF VEGETAL ORIGIN IN THE AIR PASSAGES

The Effect of Antibiotics on the Pathological and Clinical Picture

MOSHE FEINMESSER, M.D., Jerusalem, Israel

THE PATHOLOGICAL changes which take place in the mucous membrane of the air passages in the presence of an exogenous foreign body are well known, thanks to Chevalier Jackson. These changes start early when the foreign body consists of vegetable matter, in contrast to the slower effects produced by most metallic foreign bodies. Swelling of the mucous membrane occurs first, and for a short time this does not interfere with the free interchange of air in both directions. With vegetal foreign bodies a check-valve mechanism forms early, which results in obstructive emphysema as a rule. Later, the swelling of the mucous membrane closes the by-passage, the residual air in the tributary area is absorbed, and obstructive atelectasis follows. Within a few weeks pus collects, and a condition of "drowned lung" results. If this state continues, an abscess of the lung may form.

The above facts draw attention to the necessity for immediate bronchoscopy in cases in which foreign bodies of vegetal origin are inhaled into the tracheobronchial tree. When intervention is undertaken early, the reaction of the mucous membrane to the extraneous matter is still mild; the procedure may be quite easy technically, and recovery is complete after removal of the foreign body.

The sequence of events described above has changed in some cases since the introduction of antibiotic therapy. These drugs may arrest or delay the development of the usual pathological and clinical picture. They are a useful adjunct in dealing with vegetal foreign bodies but can never be a substitute for their removal, even though they may dampen down the clinical picture and so simulate a cure. When antibiotics are used the urgent removal of a foreign body by bronchoscopy is not always justified; a short delay is even preferable sometimes and allows the endoscopist to choose the most suitable time for intervention.

A few selected cases are presented below in support of these assumptions.

From the Ear, Nose and Throat Department, Rothschild-Hadassah-University Hospital.

REPORT OF CASES

CASE 1.—D. G., a baby girl 16 months of age, was admitted to the pediatric department on April 2, 1951, because of respiratory distress and cough. The following history was obtained from her parents: The child had been ill for three months. The illness began with a cold, and later difficulty with breathing, cough, and fever followed. As diphtheria was suspected, she was admitted to the infectious diseases department of another hospital, where she remained a month, but was little improved on her discharge from there. She remained under medical care and received a course of penicillin injections, which effected a temporary improvement. She had another relapse, lost her appetite and 3 kg. in weight.

When she was admitted to our children's ward she was obviously dyspneic, especially after effort, coughed repeatedly, and became cyanotic after every bout of coughing. On examination, good expansion of the lungs was noted; there was no dullness on percussion, but rhonchi were heard on both sides. X-ray of the chest was normal. Penicillin was administered, and three days later direct laryngoscopy revealed a normal larynx with freely moving vocal cords. In the subglottic region a white smooth strip of material was seen; the mucous membrane around it appeared normal, and no swelling or inflammatory changes were observed. The foreign body was easily removed by laryngeal forceps and proved to be the shell of a watermelon seed.

The respiratory distress disappeared immediately after the laryngoscopy, and the child left the hospital three days later, free of all symptoms.

CASE 2.—D. R., a boy 2 years of age, was admitted to the pediatric department on Jan. 1, 1953, because of a suspected foreign body in the respiratory tract. Three months earlier, after eating watermelon seeds, he began coughing and on the same

night began to wheeze. The symptoms persisted. X-ray of the chest was normal. Sometime later the child developed a temperature, which subsided after a few injections of penicillin. When the temperature rose again after an interval, bronchoscopy was suggested, but the parents refused permission for this. Repeated courses of penicillin were given, with a temporary drop in the temperature after each course, but the cough and wheezing were unaffected. As a result, the parents finally agreed to bronchoscopy. The child's general condition on admission was good, and no dyspnea was noted. On percussion, dullness was found at the base of the right lung, and râles were heard over the same area. X-ray of the chest disclosed atelectasis of the right middle lobe. After penicillin was given, the wheezing and cough diminished a little, but the physical findings and the x-ray appearance did not change. Bronchoscopy was performed on Jan. 27. A foreign body was seen in the right main bronchus, but, surprisingly enough, no inflammatory reaction was observed in the surrounding mucous membrane. The foreign body was removed without difficulty; it was a whole watermelon seed still enclosed in its shell. X-ray of the lungs performed a few days later showed distinct clearing of the dense patch in the right lung; the cough and wheezing disappeared completely, and the child was discharged.

No abnormal signs, either on physical examination or on x-ray, were found on repeated follow-up examination.

Case 3.—D. A., a boy 15 months of age, was admitted urgently to the pediatric department on Aug. 17, 1953, because of a respiratory distress, stridor, and cough, which had begun a few hours earlier, after he had eaten a watermelon. Physical examination of the chest was normal, but the x-ray showed slight emphysema on the left side. The child was put on penicillin therapy and was kept under observation. Bronchoscopy was contemplated but was postponed eventually because of the marked improvement in the respiration. It was considered possible that the foreign body had already been coughed out. The child was discharged four days later, apparently completely well, and an x-ray of the chest taken at that time showed that the emphysema had disappeared. One month later the child was readmitted because of wheezing and cough, but there was no difficulty with respiration. Râles were heard, and there was diminished air entry over the base of the left lung. X-ray of the chest showed emphysema of the left lung. After two days of penicillin and chlortetracycline (Aureomycin) therapy, bronchoscopy was carried out. A foreign body was seen in the left main bronchus, which moved freely on respiration, and which was removed with forceps. It was a whole watermelon seed, complete with shell. The mucous membrane of the left bronchus was apparently healthy and did not appear to be affected by the foreign body despite its long incarceration.

When the child was discharged a few days later the cough and wheezing had disappeared, and physical examination and x-ray of the chest did not reveal any abnormality then or on repeated subsequent examination.

Case 4.—G. M., a 7-year-old boy, was admitted to the children's ward on Nov. 23, 1953, because of fever, respiratory distress, and cough, which had begun four days earlier. Physical examination disclosed limited expansion of the left lung, with decreased air entry, and dullness on percussion over the base on the same side. X-ray of the lung revealed an opacity in the left base. A diagnosis of lobar pneumonia was made, and antibiotics were given. The temperature dropped on the fifth day, and respiratory distress was relieved. The child was discharged as recovered on Dec. 14, at which time the chest x-ray was normal but the breath sounds were still diminished on the left. He was readmitted on Jan. 31, 1954, because of fever and cough, and examination revealed signs suggestive of obstructive emphysema of the left upper lobe. Antibiotics were administered again, but, because of the marked improvement of the child's condition, the bronchoscopy which had been suggested was not carried out. The child was discharged with advice to remain under close observation.

He was admitted once more on March 19, because of temperature, productive cough, vomiting, and a feeling of general ill health. The breath sounds on the left were diminished, harsh rhonchi were heard, and vocal fremitus was decreased on the same side. X-ray of the chest revealed emphysema more marked than that which had been present earlier. The child was given penicillin and chlortetracycline, but the cough persisted, and the physical findings remained despite the drop of temperature on the fifth day. Bronchoscopy was performed on April 2, four and one-half months after the first symptoms had appeared. A foreign body was seen in the left main bronchus, which was extracted by forceps: it was half a watermelon seed. The mucous membrane of the bronchus was red and swollen, and there was a moderate amount of secretion.

The patient was discharged a few days later, with a considerable decrease in the cough and with much more distinct breath sounds on the left. He was followed up in the outpatient department, where repeated physical and x-ray examination confirmed the absence of any pathology.

COMMENT

As has already been mentioned, all vegetal substances irritate the mucous membrane of the tracheobronchial tree. Vegetal bronchitis

develops quickly, starting within a few hours in a baby and within a day or two in a 2-year-old child.[1] As stated by Jackson and Jackson,[1] the quick reaction of the tissues to vegetal substances is due to their irritating qualities, which are chemical or allergenic. If atelectasis persists for a few weeks, infection follows, because of lowered mucosal resistance consequent to inadequate ventilation and drainage, and a condition of "drowned lung" is established. Penicillin or other antibiotics are not mentioned by these authors when discussing the treatment of foreign bodies.

Little is written in the treatises on the subject of inhaled foreign bodies in the respiratory tract * or in the recent literature on the beneficial effect of antibiotics in cases of vegetal foreign bodies and, especially, the way they may influence the development of the clinical and pathological picture. Bonnier [4] stated in 1947 that he found penicillin to be a very useful drug in treating patients with peanuts in their respiratory passages. In many of his patients, when penicillin was injected before the foreign body was extracted, the symptoms subsided, but only for a day or two, and less inflammation and edema were noticed during bronchoscopy.

Our experience in the last few years has shown us that, while vegetal foreign bodies have undoubted specific irritative qualities, infection plays an important part in the quick development of the pathological picture. The ready response to antibiotics confirms the correctness of this view.

The pathological changes seen before the antibiotic era may not develop so early now; they may be arrested or even made to regress for a time.

In the cases presented above in which antibiotics were given not only did "drowned lung" not develop but recession of the clinical picture was evident. The symptoms and signs disappeared partly, and no inflammatory reaction was observed during endoscopy, except in the last case.

* References 1 to 3.

Occasionally the endoscopic removal of a foreign body may be delayed for a short time in cases kept under close observation. This delay is particularly important when the first attempt to remove the foreign body fails. In these cases antibiotic therapy permits a fairly lengthy delay before repeating the maneuver, and this affords time for any injury caused by the first endoscopy to heal; during this intervening period a clearing of the earlier pathological picture has been noticed often.

Two children with fragments of a peanut in their bronchi were admitted to the hospital during the past year: one with one, and one with three, unsuccessful attempts at bronchoscopic removal of the foreign bodies. In both of them the symptoms and signs subsided under antibiotic treatment, permitting a delay of more than a week before repeating the bronchoscopy under far more favorable conditions.

While there is no question that antibiotics are an important aid in dealing with foreign bodies in the air passages, it must not be forgotten that they cannot cure the condition. Once the diagnosis of a vegetal foreign body in the respiratory tract is made, the indication for endoscopic removal is not withdrawn, even when the associated symptoms and signs disappear. The symptomless interval so well known as one of the chief causes of overlooking an inhaled metallic foreign body should be taken into consideration also when dealing with vegetal foreign bodies when antibiotics are given.

In the third and fourth cases described above the disappearance of the symptoms and normal x-ray findings led to the patients' being discharged as recovered, because the effect of the antibiotic therapy was not taken into account.

It may be pointed out that the cases presented above are selected from a series of 20 with vegetal foreign body inhalation who were examined during the last four years. The effect of antibiotics was limited in some of them, others were not influenced at all, while in a few bronchoscopy had to be per-

formed immediately before there was any possibility of the antibiotic treatment having an effect. While there is no doubt that the character, size, and shape of the vegetal foreign body have an essential effect on the reaction of the tissues, the infection plays an important part in the development of the pathological changes, which can be markedly influenced by antibiotics.

SUMMARY AND CONCLUSIONS

It is assumed that in cases of vegetal foreign body in the respiratory tract infection plays an important part in the quick development of the pathological changes, which may be arrested or even made to regress for a time when antibiotics are given.

By antibiotic treatment a cure may be simulated and an error in diagnosis caused because the symptoms and signs suggesting the presence of a vegetal body in the respiratory tract may be diminished or made to disappear.

This latter development does not cause the indication for endoscopic removal of the foreign body to be withdrawn.

Occasionally endoscopy may be delayed and the intervention made easier after these drugs are administered.

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Case Reports

THROMBOSIS OF THE POSTERIOR-INFERIOR CEREBELLAR ARTERY

Report of a Case in a Patient with Chronic Suppurative Otitis Media

HARRY W. FISHLER, M.D., Los Angeles

THE FOLLOWING case history, that of a patient with chronic suppurative otitis media and hypertensive heart disease, is presented because of the unusual problems in diagnosis and treatment which arose when the symptoms of vertigo, nausea, vomiting, and hoarseness entered the clinical picture. As in this case, cerebrovascular, neurological, and otological factors may combine to tax the acumen of the clinician.

REPORT OF CASE

Mrs. S. K., aged 70, was admitted to the neurological service of the Los Angeles County General Hospital on April 11, 1952. On the day of her admission she had had a sudden and initial attack of severe dizziness with nausea and vomiting. She gave a history of a chronically draining ear on the left side, and she had had the right breast removed eight years previously for "tumor."

The patient appeared to be acutely ill and preferred to lie on her right side, since moving about in bed increased her vertigo. Her blood pressure was 220/110; pulse was 80; cardiac rhythm was regular. The heart was enlarged to the left; an apical and a basilar systolic murmur were present, but there was no evidence of cardiac decompensation. The lungs were clear. The left breast was absent. There was a purulent discharge in the left ear canal.

Two days after her admission it was noted that the patient developed hoarseness. A chest x-ray revealed no abnormality other than an enlargement of the left side of the heart. A spinal tap was done, and the findings were normal. The neurology resident considered the possibility of a thrombosis of the posterior inferior cerebellar artery, but one of the staff neurologists advised that an exploratory mastoidectomy should be done to rule out complications of the ear disease. E. N. T. consultation was requested, and the patient was transferred to this department on April 17, 1952, six days after her admission.

Examination of the patient in E. N. T. revealed the following. She appeared to be acutely ill and complained of dizziness and nausea. There was a horizontal nystagmus, which was inconstant and alternated from one side to the other in the course of the examination. The ocular fundi were normal. The tongue protruded normally in the midline, and the mouth and pharynx showed evidence of moderate dehydration. The left vocal cord was paralyzed and fixed in the paramedian position. There was weakness of the grip of the right hand as compared with the left. No motor or naming aphasia was present. No past-pointing was present.

The left ear canal contained a moderate amount of purulent secretion, which had only a slight odor. Most of the pars tensa of the drum was gone. The promontory was covered with pale granulation tissue. A granuloma, the size of a pinhead, was present on the posterior inferior side of the annulus. There was no mastoid tenderness. The fistula test was negative. X-ray revealed a sclerotic mastoid on the left side with no evidence of cholesteatoma. The Weber test showed lateralization toward the left side. The Rinne test was negative on this side. The right eardrum was intact.

A diagnosis of chronic suppurative otitis media on the left with an irritative labyrinthitis was made. It was thought at that time that the left vocal cord paralysis might be explained on the basis of the enlargement of the left heart. It was decided that an exploratory mastoidectomy should be done.

On the evening of April 17, 1952, a left radical mastoidectomy was done through an endaural incision. The antrum was found to be somewhat enlarged and lined with pale granulation tissue, but there was no cholesteatoma. No fistula could be demonstrated in the horizontal canal. There was no evidence of the extension of the disease process into the posterior or the middle fossa. The middle ear was cleaned out; all of the structures were carefully identified, but there was no remarkable evidence of disease. The cavity was packed with petrolatum (Vaseline) gauze, and the skin incision was closed.

For 12 days postoperatively the dizziness and some nausea and vomiting continued, although the mastoid wound healed nicely. There was gradual

From the Department of Otolaryngology, College of Medical Evangelists, and the Los Angeles County General Hospital.

improvement during the following week, and the patient was discharged from the hospital 20 days after the surgery. Nine weeks after surgery she still complained of some dizziness and had a tendency to sway toward the left, but she never fell. The tendency to sway toward the left side when walking was still present three months after surgery. At that time the Romberg test was normal. Finger-to-nose tests were normal on both sides. There were no sensory changes on the left side of the face or on the opposite side of the body, and the vocal cords moved equally well on both sides. In the months following, the tendency to sway toward the left gradually disappeared.

DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

The first question to be considered concerns the vertigo. Did this suddenly occurring and dramatic symptom arise from a complication of chronic ear disease involving the labyrinth? Did it occur as a result of a complication of the ear disease involving the cerebellum? Or, did it occur as a result of a cerebral vascular accident involving the posterior inferior cerebellar artery?

The next question to be considered concerns the hoarseness. Was the vocal cord paralysis due to enlargement of the left side of the heart? Was it due to a mediastinal enlargement? (Ruled out by the chest plate.) Was it part of a jugular bulb syndrome complicating the chronic ear and mastoid disease? Or, was it part of the picture of a thrombosis of the posterior inferior cerebellar artery?

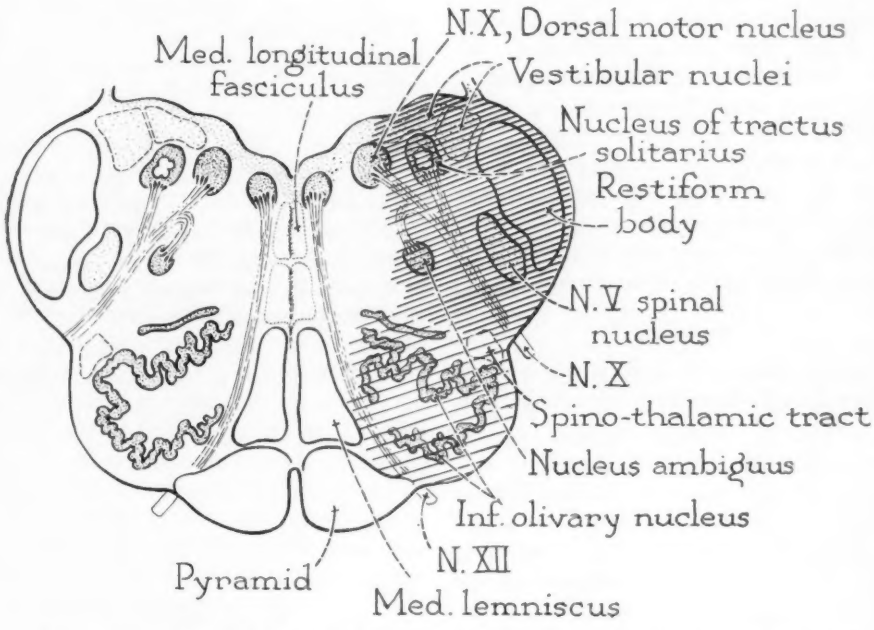
It is apparent that the patient presented problems of interest to both the otologist and the neurologist. Unfortunately, the knowledge of the neurologist about otology is often limited, and the knowledge of the otologist about neurology is likewise limited. The neurology resident's first impression was that the patient had a thrombosis of the posterior inferior cerebellar artery on the left side. His impression was not substantiated on the record by a careful work-up of the patient from this point of view, and he was discouraged from maintaining his idea by the fact that there was a coexistent chronic otitis media on the left side. He was also discouraged by the opinion of his chief, who felt that an exploratory mastoidectomy should be done to rule out complications of the ear disease. Since the pathology in the middle ear and the mastoid seen at surgery did not account for the patient's symptoms and since her vertigo and tendency to sway toward the left continued for a relatively long period after the surgery, the original possibility of explaining the symptoms and the physical findings on the basis of a thrombosis of the posterior inferior cerebellar artery was again considered. By the time I was informed about the anatomical neurology and the pathology of this condition, it was too late to elicit the classic findings of this syndrome.

The problem in diagnosis may be summarized as follows. The patient's age and her hypertensive disease were predisposing factors for a vascular accident. The sudden onset of a labyrinthine type of dizziness, paralysis of the left vocal cord, and contralateral weakness of the right hand spoke for a vascular type of lesion. The long persistent dizziness and the tendency to sway toward the left spoke against a labyrinthine lesion; compensation takes place much sooner, even where the labyrinth is destroyed, as in a suppurative labyrinthitis. Abscess of the cerebellum was excluded by the sudden onset of the dizziness, by the absence of other cerebellar symptoms, by the fact that there was no evidence of extension of the disease into the posterior fossa, no evidence of a space-occupying lesion in this region, and by the clinical course, which was characterized by gradual improvement. Consideration of a jugular bulb syndrome, because of the hoarseness, is of only theoretical importance, since the patient did not have a febrile course, and since there was no other evidence of extension of the disease into the lateral sinus or jugular bulb. From an affirmative point of view, and in retrospect, we can only make a speculative diagnosis of thrombosis of the posterior-inferior cerebellar artery.

ANATOMY, ANATOMICAL NEUROLOGY, AND PATHOLOGY

The syndrome of thrombosis of the posterior-inferior cerebellar artery was first de-

scribed by A. Wallenberg in 1895. A review of the literature from 1944 to 1953 revealed only one article on the disease in the English language, by Lewis, Littman, and Foley; they make the observation that the number of cases is greater than one would expect from the number reported in the literature. They account for this fact on the basis of the variation in the symptoms due to variations in the extent of the thrombosis. This increases the difficulty in recognizing the condition, especially among those whose experience with it is limited.



Cross section of the medulla at the level of the olive to show area of involvement and structures involved in thrombosis of the posterior-inferior cerebellar artery in a typical case.

The posterior-inferior cerebellar artery is a branch of the vertebral artery, just before it joins with its fellow from the opposite side to form the basilar artery. The main trunk runs laterally across the restiform body and between the vagus and hypoglossal nerves. Here the artery gives off branches which supply the dorsolateral surface of the medulla. Occlusion of these branches results in the classic syndrome of thrombosis of the posterior-inferior cerebellar artery. The main trunk divides into medial and lateral branches. The medial branch supplies the vermis and the lateral hemisphere of the cerebellum; the lateral branch supplies the undersurface of the cerebellar cortex.

The clinical picture in the classic case of thrombosis of the posterior-inferior cerebellar artery is explained as follows. The ipsilateral ataxia is due to involvement of the restiform body, which carries ascending proprioceptive fibers from the spinal cord and the ascending fibers from the vestibular nerve and the vestibular nuclei to the cerebellum. The dizziness, staggering, and nystagmus can be explained from involvement of the vestibular nuclei and their central connections with the nuclei of the nerves to the eye muscles. The paralysis of the palate, the dysphagia, and the voice changes can be explained from involvement of the nucleus ambiguous. From this nucleus fibers are supplied to the soft palate, pharynx, and larynx through the 9th, 10th, and the cranial part of the 11th cranial nerves. Loss of pain and temperature sensation on the opposite side of the body is explained by involvement

of the lateral spinothalamic tract. Ipsilateral loss of pain and temperature sensation in the face is due to involvement of the spinal tract and nucleus of the trigeminal nerve. The occasional ipsilateral Horner syndrome, which consists of ptosis of the upper lid, myosis, enophthalmos, anhidrosis, and flushing of the face, is explained on the basis of the interruption of the descending fibers in the substantia nigra to the intermediolateral cell masses in the thoracolumbar part of the spinal cord, where the primary neurons of the sympathetic part of the autonomic nervous system have their cells of origin. The secondary neurons, with which we are concerned, have their cells of origin in the inferior, middle, and superior cervical ganglia. If the lesion extends anteriorly, the pyramidal tract and the hypoglossal nerves are affected, resulting in a contralateral hemiplegia and an ipsilateral paralysis of the tongue. Partial lesions involving any of the above-named structures may be present, depending on the extent of the thrombosis.

SUMMARY

A case history is presented in which it was necessary to differentiate between the syndrome of thrombosis of the posterior-inferior cerebellar artery and the complications of chronic suppurative otitis media involving the labyrinth or cerebellum.

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NONCHROMAFFIN PARAGANGLIOMA OF THE MIDDLE EAR

Report of a Case

THOMAS F. FLYNN Jr., M.D., Woodbury, N. J.
JULIUS J. SMITH, M.D., Haddonfield, N. J.
and
ROMEO LUONGO, M.D., Philadelphia

THE NONCHROMAFFIN paraganglionic (N. C. P.) system composing such structures as the carotid body, the glomus jugulare, and others to be mentioned below is probably a system of organs consisting of masses of nonchromaffin tissue, closely related to the parasympathetic division of the autonomic nervous system and its ganglia. This N. C. P. system should not be confused with other systems, such as the chromaffin system, which includes the adrenal medulla and rests of chromaffin cells associated with visceral sympathetic ganglia, especially along the thoracolumbar chain and the celiac and pelvic plexuses. Other systems to be differentiated include the carotid and aortic sinuses, which are pressoreceptors, and the neuromyoarterial glomus, which gives rise to the glomus tumors of the fingers and toes.

The N. C. P. system includes such structures as the following:

1. The glomus caroticum, or carotid body
2. The glomus jugulare and paraganglia tympanicum
3. The aortic-arch bodies, or glomus aorticum
4. The paraganglia intravagale and juxtavagale, which are closely associated with the vagus nerve
5. The paraganglia ciliare, which has been described only in monkeys

In 1941 S. Guild described the structure known as the glomus jugulare, which is found in the adventitia of the dome of the jugular bulb. Since then he has described other locations in the middle ear where glomi have been found. These structures apparently vary in their location along the course of nerves traversing the middle ear, which probably accounts for differences that have been reported concerning the origin of nonchromaffin paragangliomas.

These structures have several features in common. First, their development is in close association with that of the cranial nerves and their ganglia, and the vessels of the branchial arches. Second, they are histologically similar, if not identical, to each other, and consist of nests of epithelioid cells in a highly vascular stroma. Third, they have an afferent sensory type of intervention from fibers, probably parasympathetic, to different cranial nerves. Fourth, they have no chromaffin substance, nor do they secrete any epinephrine or any other detectable hormone. Fifth, their probable function is that of chemoreceptors, able to detect changes in pH or in the CO_2 concentration in the blood which circulates through their highly vascular network. Lastly, tumors arising from them are similar to each other in microscopic structure and clinical behavior, and seem to exhibit a definite tendency toward multicentricity.

The symptomatology is nonspecific and is due to external or middle-ear obstruction. These include deafness, tinnitis, and vertigo and the objective findings of discharge, polypoid mass in the external canal, and, sometimes, facial paralysis. Some characteristic features which suggest the diagnosis of nonchromaffin paraganglioma are the following:

1. The tendency of the polyp to bleed following slight trauma

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From the Departments of Otolaryngology and Radiology, Graduate Hospital of the University of Pennsylvania.

2. A subjective sense of a pounding noise and pulsations in the ear, sometimes synchronous with the arterial pulse

3. The progressive, expansive type of growth leading in advanced stages to destruction of the temporal bone, due to pressure atrophy, and eventual extension into the cranial vault, producing compression of the central nervous system and one or more cranial nerves

4. The possibility of distant metastases

5. The generally long duration of symptoms associated with recurrences of polypi following repeated removal

Grossly, these tumors present themselves as polypi, which can be seen in the external auditory canal, and it is extremely difficult to distinguish them from common aural polypi. These are usually red to purple in color and have a mulberry type of unattached edge which presents itself in the external canal. They are polypoid in nature and vary in size from a few millimeters to a growth large enough to protrude through the external meatus.

Microscopically, these tumors characteristically show a multitude of thin blood vessels with a single endothelial lining surrounded by a reticular network. Close to the vessel spaces, large epithelioid cells with clear cytoplasm, arranged in ribbons or nests, can be seen. These cells sometimes contain eosinophilic granules and are characteristic in this type of tumor. These tumors sometimes are confused with hemangiomas, because of their excessive vascularity. Several stains have been used to bring out the reticular network, and the tumors can usually be recognized at once by a competent pathologist.

REPORT OF CASE

In October, 1952, a 57-year-old white woman was admitted to the Graduate Hospital with the chief complaint of a "pimple" in the right ear. She noticed this small growth in her right ear about four years previously but had no signs or symptoms except slight tinnitus. She had consulted her physician approximately three years previously, and at that time a small polyp was noted in the right external auditory canal, associated with a diminution in hearing. The lesion was treated conservatively, but during the course of one year it doubled in size. She was then referred to the Graduate Hospital for study. On admission, she complained of vertigo, deafness, tinnitus, and staggering. The physical examination was essentially negative except for the following findings: The right external auditory canal was filled with a large polyp, which was reddish-blue in color, nonpulsating, and nontender. There was very little inflammatory reaction. There was, however, some purulent material draining from behind this mass, which appeared to be attached within the middle ear, since it could be encircled with a probe approximately 2 cm. from the external meatus. The lesion bled very easily with the slightest trauma. The larynx showed a complete paralysis of the left vocal cord, but good compensation was afforded by the right cord.

The past history revealed difficulty in walking after the death of her brother due to meningitis thirty years previously, and she had been treated several times for "gastritis." It was thought that her ataxic gait and vocal cord paralysis were due to a previous cardiovascular accident.

Ophthalmologic examination showed the visual fields to be within normal limits. Slight arteriosclerotic changes were noted in the fundi, and minimal end-point or physiologic nystagmus was present.

Gastroenterologic consultation confirmed the diagnosis of gastritis. The laboratory examination, including S. T. S. and routine blood studies, was within normal limits. X-rays of the neck, chest, and mastoids were negative except for minimal clouding of the right mastoid air cells. An attempt at venography of the jugular bulb was made but was unsuccessful.

After being crossed matched and typed, the polyp was removed, with the patient under general anesthesia. The polyp appeared to be attached to the posterior canal wall in the region of the middle ear, although the exact origin could not be determined, due to excessive bleeding. The patient's postoperative course was uneventful. The packing was removed from the external canal within four to five days, and no further bleeding of any degree ensued.

Microscopic examination of the polyp showed an oval piece of tissue covered by squamous epithelium, ulcerated in some areas. Under these ulcerated areas rich capillary beds were seen with inflammatory infiltration and fibrous tissue. This area represented granulation tissue, but below this ulceration, in the substance of the mass per se, the sections showed a characteristic pattern. The tissue was made up of closely packed alveoli. Each alveolus was essentially a group of cells spaced rather widely but without clear-cut cell borders. There were evenly spaced oval nuclei, rather small, some dark and most of them moderately heavily granular. These cells were separated from each other by thin septa containing capillaries

(Figs. 1 and 2). The details of the cells revealed considerable uniformity except for the presence of these darker nuclei. An occasional mitotic figure was seen. Special stains were obtained to accentuate the fine fibrillar network. Figure 3 represents a silver stain showing the delicate reticular pattern. The connective-tissue stroma is readily seen with the trichrome stain (Fig. 4).

It was decided to administer deep x-ray therapy to the right middle ear. The patient received 2,000 r (air) to each of five ports, each port being 3 cm. in diameter. The ports were preauricular, postauricular, supra-auricular, infra-auricular, and directly over the external canal. The central rays were all directed to the internal auditory canal. The calculated tumor dose at a 5-cm. depth, allowing for bone absorption, was 5,000 r, delivered over a period of six weeks. The technical factors employed were 200 kv., 20 ma., 36.5-cm. skin-target distance, 0.5 mm. of copper plus 1 mm. of aluminum filtration, and half-value layer of 1 mm. of copper.

At the conclusion of roentgen therapy, the patient was free from vertigo and the tinnitus had moderately subsided. A slight, semipurulent discharge was present in the external auditory canal. Four months after her course of irradiation, only slight tinnitus was present and the vertigo had completely subsided. There was no nausea or vomiting. She has been followed for the past two years and has been asymptomatic. There has been no evidence of metastases nor local recurrence.

Rosenwasser,* who reported the first recognized case of N. C. P., believes, as do Le Compte and others, that these tumors are radio resistant and should be treated by radical surgical excision. Winship, Godwin, and van Creveld [4] reported on this subject in 1952 and stated that x-ray will control the lesion, but as far as its effecting a cure was concerned, they were doubtful. This case is being offered as one which, without radical surgery, is well two years after radiation therapy, without local, regional, or distant recurrence.

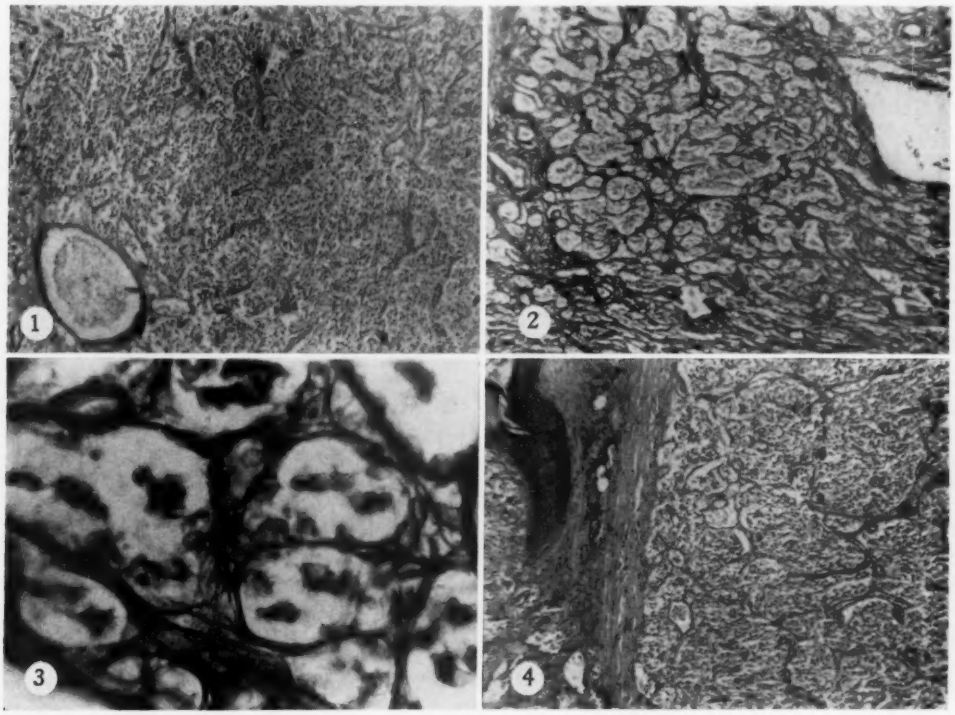

Fig. 1.—Low-power view; hematoxylin-eosin stain; reduced from mag. × 30.
Fig. 2.—Low-power view; silver stain; reduced from mag. × 38.
Fig. 3.—High-power view; silver stain; reduced from mag. × 475.
Fig. 4.—Low-power view; trichrome stain; reduced from mag. × 30.

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SUMMARY

A case report is presented of a patient with a verified nonchromaffin paraganglioma involving the middle ear. The patient was alive and well two years after treatment by radiation therapy.

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Clinical Notes, New Instruments and Techniques

THE DEVELOPMENT AND APPLICATION OF A SOFT EAR INSERT

MAJOR JAMES P. ALBRITE (MC), U. S. Army

A soft plastic ear insert has been developed at Walter Reed Army Hospital, and is currently being issued at the Audiology and Speech Correction Center to all patients requiring a hearing aid.

Because a soft insert has certain inherent advantages over the hard acrylic ear insert, Dr. Aram Glorig * felt that one should be fabricated which would be comfortable and safe and which could be molded precisely to fit the external auditory canal of each patient.

At his suggestion, the technique of fabrication of such an ear insert was undertaken jointly by Mr. Carl A. Nielson and Mr. Theodore J. Bushey, of the Army Prosthetics Research Laboratory (Lieut. Col. Maurice J. Fletcher, MSC, Director), Walter Reed Army Medical Center, and Mr. Ransom L. Currens, of the Audiology and Speech Correction Center. Dr. Glorig supervised the original design in regard to the acoustic characteristics. The soft ear insert was made of plasticized polyvinyl chloride, which met the requisites of a comfortable and easily molded ear insert. Briefly, the preparation of the compound consisted of working the plasticized polyvinyl chloride under conditions of deaeration and within a narrow range of temperature (5% tolerance). These precautions were necessary in order to retain the plasticized material within the compound. This was an important factor for the subsequent maintenance of the shape of the molded ear insert. The treated plasticized polyvinyl chloride was then poured into a cast and molded to conform to the impression taken of the individual external ear canal and the cavity of the pinna. The close tolerance possible in the casting of polyvinyl chloride assured precise fitting of the insert within the ear. The characteristics of the alginic material used in taking impressions of the cavity and external canal of the ear made exact impressions of undercuts and restrictions possible. The entire process of obtaining the impression was carried out at body temperature and caused the patient no discomfort. The next step was the stamping into the ear insert the sound channel and recess for the receiver. The product was then ready to insert into the patient's ear. The total time required for fabrication was approximately two and one-half hours.

In general, the disadvantages of the commercially available hard acrylic ear insert were overcome in the making of the soft plastic insert. Of the 1,300 inserts issued, only one case was reported in which the patient was allergic to polyvinyl chloride. Patients observed that the soft ear insert was comfortable to wear. The acoustic seal between the

Director, Audiology and Speech Correction Center, Walter Reed Army Medical Center, Washington 12, D. C.

* Director of Research, Subcommittee on Noise in Industry, American Academy of Ophthalmology and Otolaryngology.

Fig. 1.—Soft ear insert.

Fig. 2.—Hard ear insert.

walls of the external ear canal and the insert was such that no acoustic feedback occurred, thus eliminating interference with speech reception and reception of other sounds. Patients with extensive surgery involving the external auditory canal could now be fitted properly with ear inserts. Finally, by the patient's wearing the soft type insert, there was no danger of injury to the external auditory canal and the tympanic membrane in the event he fell or received a blow on the ear.

The soft ear insert might be of value in other functions, especially in the field of radio communication. It was pointed out by Dr. Glorig that, instead of the headset-and-receiver combination now being used, the receiver could be placed in the soft ear insert. This arrangement undoubtedly would be more comfortable for the user and in all probability just as efficient. Indeed, 25 flight officers assigned to Military Air Transport Service at the Washington National Airport, and Bolling Air Force Base, Washington, D. C., were issued these soft ear inserts for use in radio communication, with satisfactory results.

It is not unlikely that the soft ear insert can be used as a prophylactic measure in noisy environments. One of the chief disadvantages of the stock ear defenders is the difficulty of fitting all sizes and shapes of external auditory canals. In addition, the stock ear defenders are universally reported to be uncomfortable. The soft ear insert should overcome these undesirable characteristics.

Finally, persons engaged in underwater operations could use the soft ear insert to protect the ear from infection and strong external pressures.

SUMMARY

The process of manufacturing a soft plastic ear insert is briefly described. It is concluded that the soft ear insert is a major improvement over the hard acrylic ear insert with respect to comfort, safety, and integrity of the acoustic seal.

At present, the soft ear insert is not commercially available to the general civilian population. If it were placed on the civilian market, it undoubtedly would find wide acceptance by the thousands of hearing aid users.

Further research is being carried out on the possible employment of a modified soft ear insert as an ear defender against noise, and as a protection against infection and strong external pressures encountered by persons engaged in underwater operations.

S1271

MAGNET EXTRACTION OF BOBBY PINS FROM THE GASTROINTESTINAL TRACT

A. J. BRIZZOLARA, M.D., Little Rock, Ark.

All who practice otolaryngology and endoscopy are constantly confronted with the problem of extracting foreign bodies from the food and air passages of patients. Usually the patient is a child, for, as is known, children seem to be born with the innate desire and ability to introduce foreign bodies of all types into their ears, noses, and throats; and many of these foreign bodies find their way into the air and food passages. It is a well-known fact that most objects which will enter the gastrointestinal tract without harm through normal channels will also pass from it through natural channels without harm. This fact, however, does not always hold true, as anyone practicing medicine knows, for many foreign bodies which enter without harm do not pass, and it is this latter type with which this article is concerned.

Equen[1] has stated that until very recently a physician faced with the problem of a foreign body in the gastrointestinal tract which apparently would not pass was in somewhat of a quandary. There were two courses open to him: Either he could adopt a plan of prayerfully watching and waiting, or exploratory laparotomy could be elected. If one waited too long, there was the danger of intestinal obstruction or perforation. If operation was decided upon, it soon became apparent that the disproportion between the size of the surgeon's hand and the usual abdominal incision in a small child presented a marked obstacle in the search for the foreign object, which, at best, is difficult to locate even in an adult stomach. If the foreign body was located in a small duodenum in the thick retroperitoneal space, the trauma incident to its removal produced a high morbidity and, on occasion, death.

The quality of some substances being attracted to others, which is called magnetism, has been known to man for centuries and has always intrigued him. In times past, this force has been used for many things in medicine, usually, however, without benefit. Attempts to remove foreign bodies from the body with magnets have been made for over a century, but, with the exception of the electromagnetic removal of foreign bodies from the eye, the use of this force has been relatively unsuccessful, because of the clumsy cumbersome equipment necessary.

In the early 1940's,[1] General Electric developed and introduced a new magnet called Alnico-V, an alloy of aluminum, nickel, cobalt, and iron. It is easily magnetized and maintains its magnetism indefinitely. This magnet will lift many times its own weight, and, most important, it can be made small enough to reach into recesses heretofore inaccessible to a magnet.

In 1944, Murdock Equen,[2] of Atlanta, reported his first case of magnetic extraction of a foreign body from the gastrointestinal tract and opened the way for safe, simple removals, not only from the stomach and intestinal tract but also from the tracheobronchial tree. Since the publication of his article, there have appeared numerous articles and reports by other authors utilizing magnets for the extraction of foreign bodies.

All that is necessary for utilization of the Alnico magnet to remove a foreign body is that the object be magnetizable and that the magnet be brought in

Fig. 1 (Case 1).—Film showing bobby pin lying across vertebrae in duodenum, where it remained from time of ingestion until extraction.

Research Paper No. 1163, Journal Series, University of Arkansas School of Medicine.

Associate Clinical Professor of Surgery and Acting Head of the Division of Otolaryngology, University of Arkansas School of Medicine.

Fig. 2 (Case 1).—The magnet was started about 24 hours before film was taken. The magnet is in the stomach and not yet in contact with the pin, which has not changed position. The radiopaque string is easily seen.

proximity to it. When one is confronted with a magnetizable foreign body in the stomach or duodenum, the first thing to remember is the rule that most things entering the G. I. tract through natural

Fig. 3 (Case 1).—Film was made approximately 10 hours following the film in Figure 2 and shows the magnet in contact with the bobby pin.

channels will pass from it in the same way, without harm. If, however, the foreign body is of such great length that it is believed that it cannot negotiate the sharp turns of the tortuous duodenum or if it has been followed with serial x-rays over a period of four or five days without progression, extraction with the magnet should be undertaken.

After the foreign body is determined to be magnetizable, the next step is to bring the magnet into contact with it, with provision for retrieving the magnet with the attached object. There are various methods used for doing this, all of which have proved to be successful; and, in reporting my cases, I will describe the method I have used, which is the same as that used by Equen.[3]

The patient, usually a child, is held by assistants while a mouth gag is inserted, and the magnet attached to a string is placed into the upper end of the esophagus with the forefinger of one hand. The foreign body is usually either in the stomach or duodenum; consequently the attached string need not be over 24 to 36 in. (61 to 91 cm.) in length. As a matter of fact, it is better not to have an excessively long string, so that the danger of its getting ahead of the magnet and becoming entangled with the foreign body is obviated. This danger and the problem of kinking and knot formation in the string are decreased by using braided silk, and I have attempted to further overcome this difficulty by braiding three pieces of 00 braided (silk) together. By doing this, I have not so far had to cope with entanglement of the foreign body or knot formation in the string.

After insertion of the magnet into the esophagus, the free end of the string is brought out through one nostril with a catheter, in much the same way a postnasal pack is inserted. The string is then wound around a short piece of rubber tubing and taped to the patient's body in such a manner that as the magnet advances into the G. I. tract it can be stripped off the rubber tubing. The patient's arms are then placed in arm boards, so that he will not pull the magnet out. After this, all that is necessary is a little patience to give the magnet time to make contact with the foreign body. If the object is in the stomach, this contact usually takes place within a few hours; if in the duodenum, contact may not take place for 24 hours or longer. In any event, as the final stage of removal will take place with the patient under general anesthesia, which means the patient is to have an empty stomach, nothing more is done for several hours, usually not until the following morning. The next day either fluoroscopy or x-ray is used to see if contact has been made. If the magnet is in touch with the object, the patient is anesthetized with ether, and under fluoroscopic guidance the foreign body is extracted. This is accomplished by first bringing the string from the nose back through the mouth, then gently

pulling the magnet out of the G. I. tract by traction on the string.

Instruments should be at hand to remove the object from the esophagus in case it strips off the magnet before reaching the mouth. To date, however, I have been very fortunate in that the foreign body has not stripped off the magnet, and so have not had to resort to esophagoscopy to complete the procedure.

There follows a report of three cases of bobby pins in the gastrointestinal tract which were successfully removed by me in the above-described manner.

REPORT OF CASES

CASE 1.—J. T., a twenty-month-old white girl, swallowed a bobby pin about 6 a. m. on May 15, 1954. There were no untoward symptoms at the time except a little gagging, and the child ate her breakfast with no difficulty. She was seen by her family physician about 8 a. m., at which time x-ray examination revealed the bobby pin to be in the stomach. Films taken by her doctor at 48-hour intervals from May 15, to May 25, 1954, revealed on the first 48-hour film that the foreign body had stopped in the duodenum, where it remained until I saw her on May 26, 1954. On admission, the physical examination was normal; there were no signs or symptoms of intestinal perforation or obstruction, and her parents stated that the child had been leading a normal life in every respect. X-ray, on admission, following the ingestion of Coca-Cola showed definitely that the pin was not in the stomach, but in what was believed to be the third portion of the duodenum, in the same position it was in on the first 48-hour film made in her home town. The magnet on a string was inserted into the esophagus in the above-described manner at that time. On May 27, 1954, at 9 a. m., an x-ray film showed the magnet to be in the stomach and the position of the bobby pin unchanged. Another film made the same date, at 7 a. m., revealed the pin and magnet to be in contact; but in view of the fact that she had recently eaten a hearty meal, it was decided to defer extraction until the following morning. On May 28, 1954, the child was anesthetized with ether, taken to fluoroscopy, where the string was brought out of the mouth; and gentle traction on it brought the magnet with the attached bobby pin out of the duodenum, through the stomach and esophagus, and out of the mouth, with no difficulty. The patient's postoperative course was uneventful, and she was discharged the following day in good condition.

CASE 2.—R. M., a 3-year-old white girl, swallowed a bobby pin on the morning of July 1, 1954. She was taken immediately to her family physician, who fluoroscoped the child, revealing the bobby pin to be in the stomach. Fluoroscopy was repeated each day, and, although the pin changed position, it did not pass into the intestinal tract. I saw the

Fig. 4 (Case 1).—Film taken immediately following extraction.

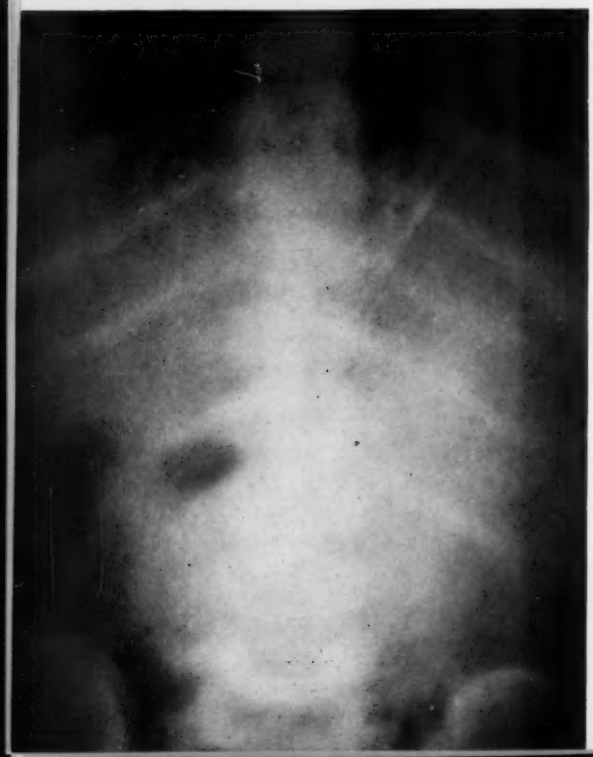
child in consultation on July 6, 1954, and an x-ray film at that time showed the pin to be in the fundus of the stomach. There were no untoward symptoms at any time following the accident, and the child continued to eat normally and to lead a normal active life. The magnet with string attached was started about 6 p. m. the same evening and orders

Fig. 5 (Case 2).—Film taken five days following ingestion reveals the bobby pin in the stomach, where it had remained since the child swallowed it.

Fig. 6 (Case 2).—Film shows the magnet in contact. (The magnet had been started the previous evening.)

left to withhold oral feeding after midnight. X-rays taken the following morning, July 7, 1954, showed that the magnet had made contact with the bobby pin. The child was anesthetized with ether and the foreign body extracted under fluoroscopic guidance,

Fig. 7 (Case 3).—A film five days following ingestion shows the pin in approximately the same location in the stomach as in Case 2.



with no difficulty. The patient was discharged in good condition the same evening after she had completely reacted, and has had no difficulty since.

CASE 3.—S. S., a 2½-year-old white girl, swallowed a bobby pin July 18, 1954, with no apparent bad effects. She was seen by her family physician, at which time x-ray films were taken, showing the foreign body to be in the stomach. She was followed by her doctor with daily films, and although the pin moved from time to time, it did not leave the stomach. The patient was referred to me on July 23, 1954; physical examination at that time revealed no abnormalities, and the child was normal in every respect. The magnet was started the same evening, at about 6 p. m., in the usual manner. Fluoroscopy the next morning showed the magnet to have contacted the pin. Anesthesia was accomplished with ether and the pin extracted on the magnet under fluoroscopic observation. The child was discharged the next morning in good condition, none the worse after the procedure.

COMMENT

There are two things which particularly interested me in these three cases besides the fact that they were all the same, came within a short period of time, and induced me to report them. First is the fact that it was in the youngest patient that the foreign body passed farthest into the gastrointestinal tract and did so rapidly, within 48 hours following ingestion, while in the two older patients the foreign bodies remained in the stomachs. Secondly, a short time previous to the first case reported, a general surgeon removed a magnetizable foreign body from the duodenum of a small child, and, although the operation was a success from the standpoint of removing the object, the child died a few hours following the surgery. This last point is made only to emphasize with what ease and with how little trauma a magnetizable foreign body can be removed from the stomach or duodenum in contrast to laparotomy.

SUMMARY

Use of the Alnico magnet to extract foreign bodies from the gastrointestinal tract is described, and three cases of bobby pins so located are presented.

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ENDOTRACHEAL TECHNIQUE FOR ADENOTONSILLECTOMY

RICHARD THOMAS BARTON, M.D.
and
D. A. ROMAN, M.D., Beverly Hills, Calif.

Endotracheal anesthesia for tonsillectomy and adenoidectomy, both in children and adults, is a trend that is growing rapidly in present-day surgical technique. It has for some time been a well-accepted technique in the adult, but its application to children has not been so extensive, even though it is well accepted in other fields of pediatric surgery. Pender and Hallberg,[1] at the Mayo Clinic, and Boies,[2] of the University of Minnesota, have both recently described their techniques of endotracheal anesthesia during adenotonsillectomy. It is our belief that the endotracheal anesthesia for tonsillectomy and adenoidectomy is just as applicable to children as to adults, and we have used this technique in 201 cases during the last two years. It is the purpose of this paper to report our experiences with this method.

It is because of the anesthesia in the majority of instances that we experience tragic complications in this type of surgery. As a result of this unhappy fact, endotracheal anesthesia is being used to avoid the complications of general anesthesia by inhalation technique. What are the requirements of the ideal tonsillectomy anesthesia? Belton and Leigh [3] state that it must be the safest and the least unpleasant and should allow the proper working conditions for the surgeon. To accomplish this, many surgeons have recently described techniques which involve the use of the Crowe-Davis type of mouth gag, the Rose position, and the use of thiopental sodium intravenously. However, in none of these techniques was an endotracheal tube employed routinely.* That this is a necessary adjunct to safe thiopental anesthesia in oropharyngeal surgery is agreed upon by most anesthesiologists. The need, therefore, for an anesthetic technique which could be used for children and adults and which would avoid aspiration, hypoxia, and laryngospasm was the challenge that led to the development of the "endotracheal tongue blade." [6] Now that the device has been applied in this series of children and adults, it appears to be the answer to the above complications and their sequelae of lung abscess, cardiac arrest, cerebral damage, and death.

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Associate Consultant in Otolaryngology, University of California Student Health Service, Los Angeles (Dr. Barton) and Senior Anesthesiologist, Saint John's Hospital, Santa Monica, Calif. (Dr. Roman).

* References 4 and 5.

SURGICAL TECHNIQUE

The instrument is a tongue blade of three sizes, designed to fit either the Crowe-Davis or the McIvor mouth gag, but so constructed that a conduit is included in the tongue depressor (Fig. 1) portion, through which an endotracheal tube is passed. The patient is anesthetized, and an endotracheal tube is inserted (Fig. 2). Thereafter, the endotracheal tongue blade is inserted into the mouth while the endotracheal tube is allowed to slide through the conduit. It sometimes is necessary to grasp the endotracheal tube with a tonsil hemostat and pull the rubber tube through the stainless steel conduit (Fig. 3). The fourth and fifth figures show the instrument in the operating room set-up, with the shank of the tongue depressor attached to the Mayo stand across the patient's chest. This provides easy access to the surgical instruments and avoids the assistant's tiresome task of holding the mouth gag up-right. The device allows endotracheal intubation without interfering with the surgical field in any kind of oropharyngeal surgery, whether it be adenotonsillectomy or the repair of cleft palate. Because the tube is inserted into the tongue blade, there is

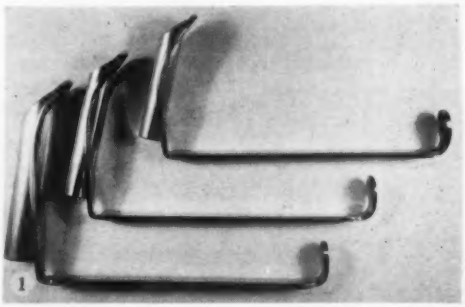

Fig. 1.—The three sizes of the endotracheal tongue blade, seen here in profile, demonstrating the conduit for the endotracheal tube attached to the depressor portion of the blade.

little protrusion into the oral cavity, and the endotracheal tube is held firmly to avoid its slipping out of the glottis or from side to side in the mouth. After the surgeon is through, the anesthesiologist may aspirate the tracheobronchial tree with a catheter through the endotracheal tube, as shown in Figure 6, and then remove the mouth gag, endotracheal tongue blade, and endotracheal tube in unison.

COMMENT

With these safeguards it is apparent, then, that with the new technique the anesthesiologist is free to use any medication or any anesthetic agent that he desires. This procedure overcomes all the objections that have been raised to the thiopental (Pentothal) techniques without intubation. The patient awakens almost immediately when the endotracheal tube is withdrawn, and his entire respiratory tract has just been cleansed of all secretions. An adequate airway has been guaranteed throughout the entire procedure, all of which are vital factors, as stressed by Steele and Anderson.[7] Many authors, including psychiatrists, pediatricians, and otolaryngologists, have recently written concerning the behavior changes in children subjected to tonsillectomy, and many suggestions have been made to prevent or reduce the amount of psychic trauma from this type of surgery. It is another advantage

Fig. 2.—The endotracheal tube is here shown in place. When the patient is sufficiently relaxed, the tube is disconnected from the anesthetic machine and the mouth gag is inserted.

Fig. 3.—The endotracheal tongue blade in the McIvor gag is here shown being inserted into the mouth, while the endotracheal tube is being pulled through with a hemostat.

Fig. 4.—The tube, tongue blade, and gag in place, before the endotracheal tube is reattached to the anesthetic machine.

Fig. 5.—The operating room set-up, with the shank of the tongue depressor attached to the Mayo stand across the patient's chest, ready for surgery.

Fig. 6.—The anesthesiologist, after the surgery has been completed, aspirating the tracheobronchial tree with a catheter through the endotracheal tube prior to removing the entire apparatus in unison.

of this technique that it permits adequate premedication by the use of rectal anesthesia for induction. This minimizes the psychological shock of the operation. Heavy premedication or the use of rectal thiopental can only be safely accomplished, however, with the employment of the endotracheal tube.

Why, one might ask, use general anesthesia for adult tonsillectomy rather than procaine? Kofler [8] answers this question, listing five advantages of general anesthesia. 1. There is less postoperative pain and inflammation, because the tissue-damaging effect of the procaine has been avoided. 2. In the case of secondary tonsillectomy, infiltration of the local anesthetic often obscures the remnants. 3. There is always some pain during a local tonsillectomy. 4. Procaine complications are reportedly as common as general anesthetic complications. 5. Pulmonary complications are commoner when tonsillectomy is done with local anesthesia rather than general anesthesia.

Another situation in which this technique is advantageous is in a postoperative hemorrhage. Here the anesthetist's problem of induction with the pharynx full of blood is exceedingly dangerous. The quick anesthesia of thiopental with succinylcholine (Anectine) followed by intubation makes this a somewhat easier and safer method of management. The disadvantages of this technique are largely those of inexperience and result from overdosage of the anesthetics or traumatic intubation. It is recognized that this is by no means an innocuous technique and therefore should not be used by the inexperienced.

SUMMARY

A technique for oropharyngeal surgery is described which provides a pleasant induction of anesthesia and, therefore, a minimum amount of psychic trauma. At the same time it guarantees an unimpaired airway, preventing hypoxia, tracheobronchial aspiration, and laryngospasm. Yet the use of the endotracheal tube through the endotracheal tongue blade does not interfere with the surgical field or handicap the surgeon in any oropharyngeal procedure.

9754 Wilshire Blvd. (R. T. B.).

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CHRONIC PROGRESSIVE DEAFNESS, INCLUDING OTOSCLEROSIS AND DISEASES OF THE INNER EAR

Summaries of the Bibliographic Material Available in the Field of Otolaryngology for 1951

EUGENE L. DERLACKI, M.D., Chicago
ARTHUR L. JUERS, M.D., Louisville
and
GEORGE E. SHAMBAUGH Jr., M.D., Chicago

THE LITERATURE on chronic progressive deafness in 1951 is still dominated by otosclerosis and its surgical treatment. Ménière's disease continues to be of topical interest. There are also many excellent contributions on the cause and treatment of deafness which warrant review.

OTOSCLEROSIS

Fowler [1] believes that the immediate underlying cause of otosclerosis and any neural deafness incidental to it is caused by autonomic dysfunction, stasis, anoxia, etc. For the past three years he has examined the circulation in the arterioles and venules in the ocular conjunctiva of all his patients and thus far, without exception, has noted a sludging of the blood and certain other vascular phenomena in every patient with deafness from otosclerosis. Patients with otosclerosis seem to be more hypersensitive and emotionally disturbed than people with nerve deafness. The autonomic reactions resulting from such emotional factors may be of basic significance.

Nager and Ruedi [2] report on the comparison between examinations of 62 parts of the labyrinth capsule gained in fenestration operations on otosclerotic ears with similar preparations from sound ears. In 54 cases complete correspondence in the two groups of preparations proved the fenestration specimens to be normal, but in 8 of the patients otosclerotic alterations could be demonstrated in these splinters. These alterations were either circumscribed regions of blue plexiform bone, containing few fibrils (Manasse's blue coats), or fully developed otosclerotic foci, and occurred only in those cases in which otosclerotic changes seemed apparent in the region of the semicircular canals during the operation.

Van Eyck [3] presents an interesting theory in explanation of how a fenestrated ear hears. Through good fortune a laboratory pigeon was found with an abnormal middle ear in which the columella (the only middle-ear bone in birds) was congenitally fixed against the oval window region, creating a situation analogous to stapes ankylosis in the human. Electrophysiological studies of the auditory functions of this pigeon's abnormal ear before and after fenestration of the horizontal semicircular canal as compared with the same studies in a normal pigeon's ear "throw some light on the respective functions of the round window and of the new window. . . . It is shown [in the pigeon] that the round window transmits the sound to the cochlea and that the new opened window permits only the compensatory liquid motions."

The author applies the above experimental results to the problem of the functions of the round window and of the new window in human fenestrations: He states

> We must logically believe that the new window allows only the compensatory movements of the liquids, like a round window in a normal ear. It does not work as a new oval window transmitting the sound to the cochlea. This function is now assumed by the round window.

Pearson [4] reviews the literature on the effect of pregnancy in otosclerosis and on the indications for termination of pregnancy when otosclerosis exists. He concludes that in rare progressive cases of otosclerosis ter-

mination of pregnancy and possible sterilization may be considered. However, abortion cannot be recommended routinely because insufficient evidence exists that it is justified for the sake of the mother or of the offspring, since the latter is not inevitably otosclerotic. In fact, "the legality of such abortion may be open to question in any save the most severe case."

House, in discussing the above paper, states that the final decision as to therapeutic abortion or sterilization must rest with the patient after all the known facts have been clearly presented. This is particularly applicable if cochlear function at the onset of pregnancy is much impaired and "any further loss due to pregnancy might result in deafness to the extent that the patient could not hear even with the strongest hearing aid."

Seligman and Shambaugh [5] reviewed 2,086 fenestration operative records to determine the incidence of otosclerotic lesions involving the lateral semicircular canal. In 61 cases (2.9%) a circumscribed focus of pathologic bone was encountered at the site of fenestration. In three of these sufficient intact bone was removed to permit histological study. The lesion proved to be that of otosclerosis. The abnormal bone is recognized under × 10 magnification at surgery by its distinct softness and friability under the dental plug finishing burr, as contrasted with the ivory-like hardness of the normal capsule. The abnormal bone also differs in color, being whiter (or pinkish when vascular) than the coarsely granular normal endochondral layer. About two-thirds of these lesions reached the lumen of the semicircular canal, and the underlying endosteal membrane at this point was always definitely thickened. It seemed to act as a limiting membrane barring invasion of the lumen of the labyrinth. In general these cases had a higher incidence of nerve degeneration and there was slightly less improvement in hearing than was obtained in the average case without otosclerotic involvement of the horizontal semicircular canal.

McHugh and Shambaugh [6] report on the histological study of a temporal bone 22 months after a fenestration operation by Shambaugh, which confirms the preoperative clinical diagnosis of clinical otosclerosis with stapes fixation. The patient's maintained postoperative hearing improvement is shown by the finding of a patent fenestra in the histological preparation. The authors show microscopic sections of the temporal bone demonstrating a patent "domed" fenestra with sharp margins of enchondralized bone, which had been achieved by the Shambaugh technique. There was no evidence of osteogenetic activity reported anywhere along the margins of the fenestra, but a small bony sliver beneath the tympanomeatal flap in the open fenestra, near its posterior end, was surrounded by a small amount of new bone. The finding of this bone spicule acting as a focus for osteogenesis emphasizes the necessity for a careful removal of adherent bone particles from the undersurface of the flap under magnification.

On the basis of his observations in 617 revisions, Lempert [7] believes that bony closure originates from the endosteal layer, and that the most effective means of preventing osteogenesis is to facilitate an intramarginal adhesion of the tympanomeatal flap to the bony walls of the fenestral rim secondary to its invagination into the fenestra gap. The tympanomeatal flap is invaginated with a special instrument, and a cotton inlay is placed over the invaginated flap and held in place with paraffinated mesh gauze. The fenestra should be made as wide as possible over the surgical dome of the vestibule.

House [8] reviewed his results in 88 fenestration cases in which complete five-year follow-up records were available, including questionnaires and audiograms. At the two-year postoperative period 55% had a loss of less than 30 db., and at the five-year period 34% had maintained a 30 db. level or better. Deterioration of nerve function seemed to occur a little less frequently in the fenestrated ear than in the opposite un-

operated on ear. On the basis of his survey, he believes that the two greatest causes of failure in obtaining a permanent hearing gain are the improper selection of cases for surgery and the predestined progressive deterioration of nerve function encountered in otosclerosis. In answer to a questionnaire, 56% were getting along satisfactorily without a hearing aid five years after surgery and 44% either wore an aid or felt the need for one.

Cawthorne [9] enlarges upon his previous reports in presenting his experiences and results in 251 cases followed over 18 months. These cases were classified in selection for operation as suitable, borderline, or unsuitable, following closely the similar classifications described by Shambaugh. Of the 251 cases, 132 maintained restoration of practical hearing up to or above the 30 db. level for the three speech frequencies, 131 suitable cases providing 88 of the successful cases and 105 borderline cases resulting in 41 successes.

Cawthorne contrasts these over-all results to those in 25 cases with pink-tinged tympanic membranes in which only 8 cases were restored to the practical level. The author reports no cases of permanent improvement in seven revisions in this series, having found bone extending into, and as a rule surrounding, the membranous canal.

Thomas [10] publishes his experiences as a "neofenestrator," following the technique described previously by Cawthorne. The results are reported in decibel gains in the speech frequencies, and well over 80% of 96 cases had a "useful improvement," which they have maintained. A variation from the usual skin flap is described using approximately the outer one-half, after a posterior incision, to epithelialize the upper part of the anterior wall of the cavity. The usual operative and postoperative complications are mentioned, with five perforated eardrums occurring, which is worthy of note. The author found that in 80% of the cases which were more than one year postoperative the ears were completely healed and dry but that the other 20%, with varying amounts of discharge, were a nuisance to both the patient and the doctor.

(Reviewers' Comment: Perforation of the tympanic membrane during or following fenestration surgery may become a permanent perforation with epithelialized margins. One of us [E. L. D.] has described a closure technique with three chances out of four of healing such perforations, and this technique has been applied to such unhealed traumatic perforations occurring in our cases.)

Another report of early experience with the fenestration operation, with particular emphasis on the usual difficulties or complications during and after fenestration surgery, is presented by McKenzie.[11] Shambaugh's method of operation was followed. The author reports particular trouble with postoperative meatal stenosis, and that this complication has lessened since he has kept the incision wholly in the soft tissue meatus and extended the upper arm of the incision to a higher level in front of the auricle. Of 78 cases from four weeks to three years postoperative, "61 have been successes, 13 failures, and 4 failures [have occurred] after improvement at first."

(Reviewers' Comment: Our use, in over 3,600 fenestrations, of the modified endaural incision, as described in 1947, has resulted in very rare instances of meatal stenosis.)

Adin and Shambaugh [12] studied the long-term hearing results in 390 cases of fenestrations in which audiometric tests were available from 5 to 10 years after operation. Seventy per cent of these patients received a significant hearing improvement (10 db. or more) and maintained it. Twenty per cent lost part of their initial gain but in many instances still had a usable level of hearing. Five per cent had no hearing improvement, and another 5% were considered to have bony closures. Most of these closures occurred during the first three years of the operative series before the improved Northwestern University technique was evolved. Symptoms of inner-ear disturbances, suggesting labyrinthine hydrops, were noted in more than 10% of the patients. Pregnancy

after fenestration did not seem to affect the hearing adversely. Progressive postoperative cochlear nerve degeneration was noted considerably more frequently in ears not operated on than in ears operated on.

Kos [13] made an analysis of preoperative and postoperative pure-tone bone-conduction and air-conduction examinations in order to formulate a more reliable method for predicting fenestration results. A detailed study of audiometric measurements of 69 patients who had undergone fenestration operations revealed that the preoperative bone-conduction threshold at 2048 cps and the cochlear reserve at 512 cps seemed to be particularly significant from the prognostic standpoint. A formula derived from this study has enabled the author to predict the postoperative level to within 5 db. in 96% of 25 cases in which it was applied. It is pointed out that this particular formula may not be suitable elsewhere if test conditions and instrument calibration vary from those existing in the author's clinic.

Shambaugh and Carhart [14] review previous publications concerning the reliability of pure-tone audiometry. Particular stress is placed on Carhart's method of "clinical calibration" of the bone-conduction receiver. Cases of clinical otosclerosis with normal cochlear reserve have, on the average, been found to have a 5 db. loss for bone conduction at the 512 level, 10 db. loss at the 1024 level, 15 db. loss at 2048, and 5 db. loss at the 4096 frequency. After fenestration this loss is restored so the bone-conduction threshold will again be at the 0 line. This preoperative loss has been termed the "Carhart notch." A formula for predicting the best result obtainable by fenestration has been formulated, incorporating the factors of the "Carhart notch" and Davis and Walsh's observation that the postoperative air-conduction level is at best 25 db. below the bone-conduction threshold as usually recorded on an audiometric chart. Davis made his studies using speech tests rather than pure tones. The Shambaugh formula consists of two steps. First, a correction is made for the "Carhart notch," i. e., predicting the postoperative pure-tone bone-conduction threshold. A line drawn 25 db. below this threshold will be the anticipated air-conduction threshold after operation. Comparisons of the performance of the fenestrated ear with that of the ear with the hearing aid show that in ideal "A" patients surgery is the rehabilitative procedure of choice. In less suitable cases the results of surgery tend to be inferior to those obtained with the hearing aid in volume of hearing though superior in clarity.

Auditory tests concerning interrelationships between speech tests and pure-tone tests on over 100 additional fenestrations are reported by Thurlow and associates.[15] The results agreed very closely with those reported previously by them. The maximum articulation score was significantly higher when the lists were given by "live voice" as compared with the recorded voice. The score was slightly lower for the patients with some high-tone nerve loss. There was no significant correlation between the size of the fenestra and the degree of hearing improvement. The pure-tone tests revealed less gain for the 2048 and 2896 cps than for the 512 and 1024.

Nilsson [16] reports on the results of hearing tests performed in 15 cases during fenestration surgery under local anesthesia. Opening of the mastoid and removal of the incus and head of the malleus did not influence the hearing, but opening of the labyrinth resulted in immediate maximal hearing improvement, which is slightly decreased by placement of the flap over the fenestra. An immediate improvement of bone conduction at uncapping of the window also was found in line with the previous reports by Juers, Woods, and Carhart. The author reports one case four weeks after the operation:

> The effect of this [excessive early postoperative] mobility of the drum membrane is that the sound enters the tympanic cavity and via the round window interferes with the sound entering via the new window. By covering the drum membrane with a paraffined cotton-plug this interference is diminished and the hearing is improved.

The same cotton plug over the fenestra causes a definite decrease in hearing. This and other procedures led to the author's con-

clusion that Lempert is correct in stating that the mechanism of fenestration is "a new air conduction mechanism which permits the perilymph and endolymph to be freely mobilized again by air borne sound."

Otosclerosis in the round-window region is discussed as a possible cause of failure in fenestration surgery in some cases with typical clinical otosclerosis and good cochlear function.

Mol [17] presents a graph, called the dynamogram, for plotting the increase in loudness of a pure tone as its sound pressure level is increased above the threshold. The loudness increase is expressed by progression in loudness perception with arbitrary spacing on the vertical axis from just audible to pleasant and then to sharp, with the corresponding sound pressure levels along the horizontal axis. Dynamograms on more than 100 normal ears established the range of slopes to be expected. The author believes that the slope is controlled by the intra-aural musculature, particularly the stapedius muscle; and since the stapes fixation of otosclerosis excludes the regulating action of the auditory ossicular muscles, the dynamogram of the otosclerotic ear is simply the dynamogram of the cochlea. Pure cochlear and otosclerotic dynamograms are shown by examples to be more steep than those in normal ears, and the author suggested the dynamogram as a diagnostic aid in cases of a suspected fixation of the ossicular chain. Another finding was that fenestration of an otosclerotic ear reduces the hearing loss but does not change the slope of the audiogram. The author concludes that since the fenestrated ear is deprived of its protective muscle-controlled ossicle chain (its steep dynamogram being similar to "tender" ears tested) it is liable to acoustic trauma.

Hughes [18] reports on the production of a relatively bloodless field in 10 fenestration operations by lowering the systolic blood pressure to between 75 to 85 mm. Hg with intravenous pentamethonium and posture control. The pentamethonium acts by paralyzing the autonomic ganglia at the preganglionic synapses and lowers the blood pressure by vasodilatation without producing shock. There were no complications in the 10 fenestrations performed with this "controlled" hypotension technique maintained as long as three hours. The blood pressure returned to a low normal level within an hour after surgery, and no postoperative ill effects, such as hemorrhage or aggravation of the postoperative labyrinthine symptoms, appeared.

Taillens [19] reports the reasons for the composite technique he uses which employs the two-stage operation and the retroauricular approach advocated by Sourdille, and the removal of the incus of the American school of Lempert and Shambaugh. The two-stage operation is considered superior because the fenestra is made in a dry field already adapted to its new "biologic relations" with the environment, and a tympanolabyrinthine flap of good quality can be secured which has adapted itself to any anatomical peculiarities and healed any defects created by the surgeon. The retroauricular approach enables Taillens to accomplish the making of a fenestra on a domed and enchondralized labyrinth. This approach is also considered advantageous because "the regional surgical reference points can be [better] identified from the vantage . . . well known to all otologists . . ."; the probability of injury to the facial nerve is decreased; the plastic changes possible in the external auditory meatus afford a "facilitated operatory and postoperatory technique" and view; reopening the cavity at any time is easier. The incus is removed in order to position the fenestra near the ampulla of the horizontal semicircular canal.

(Reviewers' Comment: This hardly seems necessary. Certainly every point advanced as an advantage for the postauricular approach can be used as an argument for the endaural approach in our hands.)

Menck-Thygesen [20] reports the sudden loss of hearing in both ears in a patient undergoing fenestration one year after a first fenestration upon the other ear "without any improvement." The author's operative re-

ports indicate a technically difficult fenestration, during the course of which the membranous labyrinth was accidentally injured. The complete hearing loss was still present, as was an improving peripheral facial palsy on the side of the second operation, at the time of a complete neuropsychiatric examination two months after surgery, when psychogenic hearing loss was felt to be ruled out. Various theories of explanation are advanced, many other authors being quoted who have reported hearing improvement in the ear not operated on after fenestration of the other ear, to show that the acoustic function in the contralateral ear can be influenced by fenestration operation.

(Reviewers' Comment: Unfortunately, objective evidence for some of the author's conclusions is not available. Only one postoperative audiogram is reported as taken some time after the fenestration of the first ear, which showed a 90 db. level, a loss of 38 db. from the preoperative level. This could be a "shadow-curve" hearing in a dead ear, if masking was not used, and we cannot be certain that the author is correct in stating "that it was just a case of two successive traumas of the acoustic nerves . . . can be considered out of the question.")

MÉNIÈRE'S DISEASE

Eby and Williams [21] did alternate binaural loudness balance tests and detailed speech studies in 16 cases of nerve deafness due to degeneration of nerve fibers and in 32 cases of Ménière's disease. Eight of the nerve tract lesions were due to angle tumors, which were confirmed at surgery, and in all eight cases recruitment was absent preoperatively. Of the remaining eight with nerve tract lesions, there was no recruitment in five and incomplete recruitment in three. In five of the six patients on whom speech tests were performed, there was a gradual increase in intelligibility with an increase of intensity. The dynamic speech range in these cases, i. e., the difference between threshold and the most comfortable level, was 28.5 db.

In contrast to these cases of nerve tract lesions, 32 cases of Ménière's disease (end-organ lesions) all revealed the presence of recruitment. Overrecruitment was present in 17. Speech intelligibility tests were made in 17 of the end-organ cases, and in 15 of these the intelligibility reached a maximum and then declined with further increase in intensity. The dynamic range of speech was narrowed to 18.4 db. The threshold of discomfort was lower in cases of Ménière's disease than in those of nerve tract lesions.

McKenzie [22] presents a differential diagnosis of Ménière's disease from various cases seen in his hospital practice, which are divided by symptoms into three groups, namely, those with deafness and vertigo, those with vertigo alone, and those with deafness alone. Cases to be differentiated in the first group were illustrated by patient reports of acute labyrinthitis, chronic infection, as in a fistula from cholesteatoma, past infection with an inactive otitis media, vertigo after radical mastoidectomy, otosclerosis, syphilitic deafness, acoustic neurofibroma, and, finally, neurolabyrinthitis. The second group of cases—vertigo without deafness—to be differentiated from Ménière's disease are illustrated by case reports of neurosis, epilepsy, disseminated sclerosis, and positional vertigo. The case report of deafness without vertigo otherwise conforms so completely to the findings in Ménière's disease that the author feels a close relationship in such cases is very likely.

(Reviewers' Comment: We certainly agree with the last opinion; in fact, we feel that Williams states this more accurately when he points out that the cardinal sign of Ménière's disease is not the vertigo but rather the inner ear type of deafness with more involvement for the low tones than the high and usually with diplacusis.)

Ersner and associates [23] present the intratympanic injection of anesthetics for the treatment of Ménière's syndrome. Their technique is described in detail. Thirty-seven patients who did not respond to medical measures were selected for treatment. Immediately after the injection there was a marked vestibular reaction, with further loss of hearing. Vertigo was relieved in 11, im-

proved in 9, and unchanged in 17. Tinnitus was relieved in 19 and continued in 18.

Hanson [24] treated five cases of Ménière's disease with streptomycin. The dosage given was 2 gm. per day. The toxic effect seemed to have a selective action early on the involved ear, as evidenced by a gradual loss of caloric response in this ear, while the uninvolved ear continued to respond normally to the caloric test. Streptomycin was given until no caloric response was obtained in the diseased ear. The period of treatment varied from 20 to 43 days. There was in general no change in hearing. One patient with bilateral involvement lost response to caloric stimulation in both ears during treatment, but some function had returned 15 months later. Vertigo was completely relieved in all patients immediately after the completion of treatment, but there was a slight recurrence after a period of recovery, but not sufficient to interfere with work. In each case there was total incapacity to work before treatment, and all have now been restored to full employment. In order to obtain an irreversible loss of vestibular function, the author plans in the future to give 3 gm. of streptomycin divided into two doses daily and to carry on the treatment for five days beyond the period of the loss of cold caloric stimulation response. It will be discontinued, however, immediately during this five-day period should there be any reduction of response in the uninvolved ear.

In order to obtain additional information about the histological changes following intralabyrinthine surgery, Altmann and Montreuil [25] carried out Day operations on several monkeys. Penicillin was given postoperatively in order to lessen the likelihood of labyrinthitis. Microscopic studies of the temporal bones revealed that electrocoagulation caused necrosis of certain parts of the membranous labyrinth and that this was followed by secondary reparative changes which consisted at first of ingrowth of connective tissue extending somewhat beyond the initial necrosis. Later bone was frequently formed. The extent of the change seemed to depend chiefly on the intensity of the current used. Interpretation of changes in the cochlea were more difficult to evaluate. However, it seemed certain that, even without infection, the coagulation necrosis was followed by a diffuse serous aseptic labyrinthitis. Clinically, in an attempt to reduce the intensity of the postoperative serous labyrinthitis, the strength of the coagulating current was reduced in various degrees in operating in two cases of Ménière's disease. The result, however, was unsatisfactory, since the dizziness was not completely eliminated but the hearing was nevertheless completely lost. It would seem, then, that any attempt to decrease the intensity of the coagulating current in order to preserve the hearing is useless and jeopardizes the elimination of vertigo.

Another surgical approach used was that of plugging the membranous lateral semicircular canal with a bone chip without using coagulation. Experiments with this technique on monkeys showed that a circumscribed fibrosis developed around the bone chip, with no definite changes in other parts of the labyrinth. This procedure was carried out in three cases of Ménière's disease. In two of these the vertiginous attacks were practically stopped and some of the hearing was retained, but not at a level to be of any practical value. In the third case the attacks continued unchecked, and the hearing was completely lost. In view of these failures this surgical approach does not appear to be reliable.

The experience with the surgical management of Ménière's disease by the most popular surgical procedures at the Lahey Clinic is discussed by Lathrop.[26] In the past 13 years 91 patients have undergone intracranial complete or differential section of the eighth cranial nerve. Of the 91 patients, 62 were completely relieved of their acute vertiginous attacks, 9 perceived no change, and 18 patients could not be traced. Temporary facial paresis occurred in two patients. In contrast, electrocoagulation or avulsion of the membranous horizontal semicircular canal was carried out in 25 patients,

with complete relief of vertigo in all patients. Two temporary facial pareses occurred in the group of 20 undergoing electrocoagulation procedures.

Lathrop feels that the surgically less difficult labyrinthotomy, with its much shorter period of hospitalization and economic incapacitation, is preferable to the technically more difficult differential section of the nerve, unless the hearing is bilaterally good, or Ménière's disease is thought to be bilateral.

Green and Douglass [27] did a follow-up study of 587 patients with Ménière's disease on whom intracranial division of the eighth nerve had been performed by Dr. Walter Dandy. There were two deaths in the series due to meningitis. Of 114 patients with tinnitus who had section of the entire nerve, 42 (32.9%) reported complete relief of their tinnitus. Of those with section of the vestibular portion of the nerve, 26.8% had relief of tinnitus. There were 64 patients with partial section on whom adequate follow-up audiometric studies were available over a period of 5 to 17 years. Of these patients, 5 experienced some improvement in hearing, 12 showed no change, 36 were somewhat worse, and 11 had no hearing in the ear operated on. The relief of vertigo was essentially the same in the partial section group, as it was in the group with complete section. Complete relief of vertigo was obtained by 91%, while 5% were improved, and 4% were unchanged. Permanent facial paralysis occurred in 9% of those with complete section and in 1.7% of those with partial section.

Castellano [28] also reports on a large series of 254 cases subjected to intracranial section of the acoustic nerve over a 20-year period (from 1930 to 1949), part of which had previously been reported by Olivecrona. There was no operative mortality. Tinnitus rarely disappeared; 3 of 27 patients reported complete relief of tinnitus after complete section and only 2 of the 226 with vestibular section had complete relief. Of the 254 patients operated on, 246 (96.8%) obtained complete freedom from dizziness. In the 226 cases of vestibular nerve section, the ear operated on was totally deaf in 46 cases during the postoperative period, further impaired in 26, unchanged in 149, and somewhat improved in 5 patients. In 16 cases facial paralysis occurred, being permanent in 2 (0.8%). Postoperative extradural hematomas occurred in five patients. The author's only mention of other operative procedures besides nerve section is in the statement "The operation may be performed on the labyrinth or on the nerve trunk, but the former is now seldom done."

(Reviewers' Comment: The last statement might be attributed to wishful thinking rather than to a scholarly reporting of facts. It is interesting to compare the results of the author's report, in which tinnitus was rarely relieved, with the significant percentages of relief obtained in Dandy's series of nerve sections.)

Passe [29] reports on the relief of symptoms in Ménière's disease, idiopathic nerve deafness, and tinnitus by sympathectomy carried out in 110 cases. The author reviews the physiology of the autonomic nervous system, as he has done in the past, and describes the technique of interruption of sympathetic control of the blood supply to the internal ear by either procaine block or a posterior extrapleural upper dorsal sympathectomy. The indications for operation are improvement or relief of symptoms in the abovenamed conditions by a stellate ganglion or a parasympathetic procaine block. Of 88 cases of Ménière's disease, six months to three and a half years postoperatively, 72 (82%) showed complete relief of vertiginous attacks, but no actual percentages of relief of tinnitus or of impaired hearing are given. In 13 cases with tinnitus as the predominating symptom, the surgery gave complete relief to 5 patients and partial relief to 8 patients, exactly as demonstrated in the preoperative procaine block. The nine cases of idiopathic perceptive deafness in young people between 11 and 34 years of age "all gave an improvement audiometrically with procaine block before operation, and this improvement was obtained and in some cases

increased as the result of the operation." Passe states:

> Therefore upon this evidence I present a method whereby the restoration of the aural sympathetic-parasympathetic balance can, in selected cases, undoubtedly improve the function of both cochlear and vestibular organs and restore the great majority of patients crippled with Ménière's disease to a useful life.

Rosen [30] treated intractable cases of Ménière's disease with a new surgical procedure consisting of section of the chorda tympani and tympanosympathectomy. The objective is relief of symptoms without destruction of the function of the inner ear. Fourteen patients were operated on by this technique. Eleven have had no vertigo since the operation. In one patient with only cochlear symptoms, the hearing has returned to a high level and remained so. Tinnitus was completely relieved in one, diminished in seven, and remained unchanged in six. In no case was the hearing destroyed.

MISCELLANEOUS

Harrill [31] points out that headache and, to a lesser extent, vertigo are common symptoms experienced by some persons with low blood sugar. In practically every case the headache and vertigo are reproduced during the course of the five-hour glucose tolerance test. In some there is a history of symptoms occurring at night or before meals. These patients usually respond well to a diet high in protein and low in carbohydrate.

Ruedi and Furrer [32] noted that jet engines produced an unusual type of acoustic trauma. An analysis of the noise revealed that an idling engine produced almost a pure-tone sound, with a peak at 850 cps at high intensity. At full engine speed some additional higher frequencies were produced. Four persons with normal hearing were exposed to this engine noise near the plane, two with ear defenders and two without. Those without protection sustained a loss for the middle audiometric range, with a sharp notch at the 1500 frequency. Pitch increases up to 30% were present in the 800 to 2000 cps frequency range. The deafness and diplacusis disappeared within three days. Those with protection had no loss. Two mechanics who had been exposed to these engines for three to four years revealed, on audiometric examination, normal hearing up to the 1000 frequency and then a wide deep notch with some return at the 13,000 to 16,000 frequencies. While pilots obtain some degree of protection from the cabin, all ground personnel should use some type of ear defender.

Schuknecht and associates [33] subjected 10 conditioned cats to head blows. In general the degree of acoustic trauma was proportional to the severity of the blows. The post-concussion audiograms of these animals revealed hearing losses which were most severe for the high tones, particularly in the region of 4000 cps. Gross and microscopic studies failed to demonstrate significant pathology in the middle ears and brains. Graphic reconstructions of the cochlea were made. The primary injury was found to be a degenerative change in the organ of Corti. The upper part of the basal coil was most susceptible to injury. In the order of severity, the recognizable stages of end-organ damage were (1) loss of external hair cells, (2) loss of the external and internal hair cells, and (3) flattening of the organ of Corti. There was secondary degeneration of the nerve fibers and ganglion cells supplying the damaged regions of the cochlea. End-organ changes responsible for reversible hearing losses were not demonstrable by ordinary histological techniques.

Davis [34] attempts to define our knowledge of the effects of noise on man, using the information gained by Dr. Karl Kryter in a critical survey under a contract between the Office of Naval Research and the Central Institute for the Deaf. A condensation of the findings of the first section of the report, entitled "Noise and Behavior," is quoted:

> This survey shows that nearly all industrial and laboratory experiments which report that noise adversely affects work [any mental and motor tasks not involving communication by speech] output are open to criticism because of poor experimentation and uncontrolled factors . . . experiments carried out with proper control of all pertinent factors re-

veal that steady or expected noises do not adversely affect psychomotor activity to any significant extent.

Conclusions on the deafening effect of noise are more positive and include the following statements:

The maximum safe intensity at which no deafening effect will occur is probably in the neighborhood of 85 db. above .0002 dyne/cm.^{2} for "critical bands" of noise. The overall intensity of a noise in decibels usually will not correctly indicate its deafening effect.

The effects of noise on communication by speech is summarized by Davis' quote of Kryter: "Probably the most deleterious effect that noise has on man's behavior is the disruption or 'masking' of speech communication."

Hamberger and Liden [35] did a follow-up examination of the hearing of 76 men out of a group of 161 military personnel originally tested approximately five years previously by Hagerman. In the original study by Hagerman all of the 161 persons had been found to have had impaired hearing from exposure to small arms as well as artillery fire. The authors' present study showed that only 6 out of 76 patients had normal audiograms, and 4 of these 6 had shown recovery within three months, as shown by Hagerman's investigation. This meant that only two cases showed any further recovery to normal after three months. The authors conclude:

Thus, to a great extent, auditory impairment caused by acoustic injuries, which has not regressed [recovered] after three months will subsequently become permanent. If new injurious factors intervene, the impairment will become more pronounced.

Christensen and others [36] studied the toxic effects of streptomycin on the acoustic vestibular system in guinea pigs. Dosage was varied from 100 to 400 mg. per kilogram for periods of four to six weeks. Vestibular reaction and hearing were abolished only in the animals receiving the largest dosage. In all cases histological investigations revealed degeneration of the nerve cells in the central vestibular and cochlear nuclei. The extent of the changes was proportional to the amount of the drug given. The sensory cells in the labyrinth showed no signs of degeneration, even in the severest streptomycin intoxication.

Ruedi [37] studied the toxic effects of streptomycin on the auditory apparatus of guinea pigs. Six to 30 gm. were given to each animal. All animals lost vestibular function, and a variable degree of sound perception was noted. Histological examination of the temporal bones revealed a definite degeneration of sensory epithelium in the vestibular structures. The organ of Corti also showed degenerative changes in the hair cells, especially in the first turn. The corresponding stria vascularis exhibited marked pathological changes. Some degenerative changes were noted also in the spiral ganglion cells and axones. Central nervous system changes were not as severe. Histological studies were made of the temporal bones of 24 patients who died of tuberculous meningitis. All had received intensive streptomycin therapy. Though it was difficult to evaluate the findings, the author believes that the degenerative changes found in the sensory endings of the human ear agree somewhat with those found in experimental animals. Three cases of Ménière's disease treated with streptomycin are reported. He advocates not using over 2 gm. of the drug per day.

Glorig [38] studied the toxic effect of dihydrostreptomycin on the vestibular and auditory mechanism as compared with the effect of regular streptomycin in cases of tuberculosis. These patients received from 1 to 3 gm. of dihydrostreptomycin daily for from one to six months. Of the first group (61 patients), 22.9% developed deafness. The incidence of deafness was greater in those receiving the larger doses of the drug. In most instances the deafness developed one to five months after therapy had been discontinued. Vestibular function was lost in 17% of this group. In another group (150 patients) hearing tests were done but no vestibular tests were carried out. Thirty-one per cent of this group developed hearing impairment, varying from mild (30 db.) to severe (greater than 80 db.). The loss was always symmetrical and rarely became evi-

dent in less than three months. In view of the fact that dihydrostreptomycin seems to have a greater toxic effect on the auditory portion of the eighth nerve than does regular streptomycin, Glorig believes that for prolonged therapy streptomycin is preferable to dihydrostreptomycin. The deafness is of the perceptive type, with poor discrimination, and is not benefited much by a hearing aid.

Biagi [39] reports on 17 cases of tuberculous meningitis treated with streptomycin and 13 cases treated with dihydrostreptomycin. There were 14 recoveries with streptomycin and 8 recoveries with dihydrostreptomycin therapy. The adult dosage and course of treatment of either drug, with appropriate reductions in dosage according to age for children, was 2 gm. daily in two doses intramuscularly for four months and 100 consecutive intrathecal injections of 50 mg. daily. After a rest period of from 14 to 28 days a second course of 2 gm. daily for three months intramuscularly and 50 intrathecal injections of 50 mg. at two-day intervals were given.

All 14 recovered patients treated with streptomycin have been discharged and carefully followed, and every patient can hear a forced whisper at 12 ft. (4 m.) without difficulty. Dependence upon gross testing rather than on audiometry was necessary, since no otologist was available. Of the eight patients recovering with dihydrostreptomycin therapy, four developed a marked hearing impairment: in one patient the loss occurred rapidly in a 14-day period during the fifth month of treatment; the second patient became even more rapidly totally deaf (in 4 days) during the second month of the second course, and the other two showed the first evidence of partial deafness one month after discharge from the hospital. One of the latter two was examined by an otologist a few months later and had profound nerve deafness. Thus, Biagi concludes that, once the auditory nerve has been damaged by dihydrostreptomycin, progressive impairment of hearing may occur after all therapy has ceased. In conclusion, Biagi states, "There appear to be no grounds for continuing to treat cases of tuberculous meningitis with dihydrostreptomycin rather than streptomycin."

(Reviewers' Comment: We are in complete accord with the last statement, but we would substitute streptomycin for dihydrostreptomycin in every case of indicated therapy with the drugs.)

Blegvad [40] states:

> . . . the experiences from two world wars have shown that deafness resulting from the effect of a strong sound upon the ear sometimes associated with a marked increase in the air pressure in some cases is entirely psychogenic. Only in very rare cases, perhaps never, is the deafness entirely of organic nature. . . .

A number of symptoms are highly suggestive of psychogenic deafness, according to the author and other quoted writers as follows:

> Agitation and anxiety during interviews.
>
> Variability in the outcome of hearing tests on different days.
>
> Discrepancy between hearing for voice and speech audiometry and pure tone audiometry.
>
> Striking gain or lack of gain in hearing with the hearing aid.
>
> Flat audiograms.
>
> Positive Doerfler-Stewart test.
>
> Lipreading ability is apparently often rapidly acquired, but when the patient is asked to read lips of whispered voice while his canals are plugged, he fails.

Blegvad emphasizes that the relief of emotional deafness is through psychotherapy by the otologist as well as the psychiatrist or psychologist. The greatest obstruction to the prospect of recovery is that often a military or civilian disability pension depends upon the persistence of the hearing loss.

Christensen [41] discusses the psychology of the progressively deafened person in young adult life from his personal experiences. He states that the principal attention of normal hearing persons, even professional psychologists, is nearly always only directed to the depression and suspiciousness of hard of hearing. This is too superficial a view. The lack of auditory stimuli causes the deaf to be self-centered, and this is intensified by having to declare the defect of deafness to strangers too frequently. The author feels that often

the deaf person does not miss so much what is said as how it is said. This inability to perceive the inflections and nuances of speech limits the evocation of feelings of warm friendship, affection, and sympathy in their human relationships. Christensen states:

> The psychic stimulation of music is obvious to all. The influence of military music on marching soldiers shows that this stimulation influences the physique as well. . . . You can take it that the "tone from life" has a similar effect. When "the melody disappears" it affects the physical power and energy as well.

The author makes a plea for scientific analysis of the psychology of hearing by group examinations and systematic experimental observations of the person with impaired hearing. At the same time "psychic therapy" should be started for the purpose of "adjustment to the hearing defect and to counteract all the psychic handicaps the hearing defectives are in danger of."

Podolsky [42] calls attention to the distressing development of emotional problems in the person undergoing a handicapping loss of hearing. The social insecurity from difficulty in communication with a normal hearing society and the anxiety from being unable to depend on one's ears in crowds or traffic pile tension upon tension. The inability to rid themselves of inner doubts and anxieties by conversation causes frustration in the deafened. Similarly, the limitation in the social contacts in club activities and in games restricts an adequate outlet for the normal aggressive drives by the deaf.

Adams [43] reports on a clinical survey since 1942 of 22 men and 6 women with exostoses of the external auditory meatus who have answered a thorough questionnaire as to swimming and bathing habits as well as family and individual hearing history, and have had audiograms taken. The survey confirms the views of several previous authors that lowering of the external canal temperature below body temperature by cold water entering the canals is the major cause of exostoses of the bony meatus.

The 28 cases in the survey yielded 3 men and 2 women with social deafness, and subsequently the author discovered 4 more men and 1 woman with hearing impairments associated with exostoses. The finding of a perceptive hearing loss in 9 of the 10 cases offered no support for the supposition that hyperostoses developed on the inner wall of the middle ear (causing a conductive loss) in association with exostoses in the external canals in swimmers, as suggested by such authorities as Politzer and Dan McKenzie in earlier textbooks.

Tamari and Itkin [44] made a comprehensive study of 310 established syphilitic cases to reevaluate syphilis of the ear since the introduction of penicillin in syphilotherapy. In this series of random samplings of the different types of syphilitics, the authors took considerable care in establishing the inferential clinical diagnosis of syphilitic nerve deafness, even though they observed that syphilis is not responsible for a characteristic pattern of loss. The authors conclude that penicillin is more effective in the treatment of syphilitic nerve deafness than has been observed after any previously described treatment, except in early or late congenital syphilis, where it is unsuccessful even in arresting the progress of the impairment, and in late asymptomatic or symptomatic neurosyphilis, the clinical results are unchanged from the prepenicillin days. In contrast, nerve deafness in late or late latent syphilis showed response to penicillin therapy in an improvement or arrest of impairment. An even more striking observation was that not a single patient with early or early latent syphilis receiving penicillin at an early stage of the infection developed an eighth nerve involvement. A marked improvement or even restoration to normal occurred in the nerve deafness of acute syphilitic meningitis from penicillin therapy in three cases.

Saltzman and Ersner [45] present several examples of V-shaped and U-shaped audiograms characterizing various cochlear lesions. They conclude that high-tone V- or U-shaped defects are caused by acoustic trauma most frequently and less commonly by infections. The low frequency defects of similar shapes are, by comparison, of obscure origin; how-

ever, their clinical picture of these cases suggests to the authors either a congenital lesion or an unrecognized attack of mumps or some other infection as the possible etiology.

(Reviewers' Comment: Mumps, in our experience, causes a total or near-total unilateral nerve deafness rather than the type of bilateral defects described by the authors.)

Kuhn [46] again, as he has in the past, calls attention to the allergic factor in certain types of hearing impairments and chronic middle-ear infections. In patients who present themselves with a hearing loss which is highly variable in degree and time of occurrence, associated with fullness, dull pain, and deep burning in the ear affected, as well as itching in back of the nose, one must suspect the possibility of an allergic etiology. The findings of an allergic rhinitis, with nasal eosinophiles, edema of the Eustachian tube orifices, and, often, edema of the middle ear mucosa pouching out through a myringotomy, are suggestive findings in the allergic deafness syndrome. Kuhn's diagnostic test in such cases is to take an audiogram before and 20 minutes after a hypodermic injection of "half the therapeutic dose [8 minims in an adult] of epinephrine." Two case reports show a considerable hearing improvement with the epinephrine test, which warranted a successful allergic investigation and treatment. The author also called attention to the importance of searching for eosinophiles in the secretion from chronic therapy-resistant middle-ear infections, to help establish the allergic etiology in these cases, and to lead the way to proper allergic management.

(Reviewers' Comment: We subscribe to the author's emphasis upon the role of allergy in otology. The best results in the diagnosis and therapy of the allergic ear conditions are obtained when the otolaryngologist makes his own allergic management in these cases.)

Schall and associates [47] made histological studies on three temporal bones of two 4-month embryos, operatively removed from mothers who suffered rubella in the second month of pregnancy. Hyperemia and free hemorrhages were seen. In the most critical period the specific infectious agent causes arrest of development of the end-organ, and vascular damage, the latter possibly being the primary change. Vulnerability of the vessels shows up at the end of the pregnancy in an increased tendency for birth injuries.

Baron [48] reports the results of a study of 36 patients with varying forms of deafness and tinnitus treated with intramuscular injections of vitamin A. There were but three patients with improved hearing and four with lessened tinnitus. He believes that these results show no superiority over other forms of therapy presently available.

Opheim [49] reports on the treatment of three cases of acute cryptogenetic total deafness (sudden deafness) by fenestration. On the assumption that the sudden loss in hearing may be due to an acute rise in labyrinthine pressure, the author reasoned that fenestration of the labyrinth might well have a decompressive effect and result in a return to functional ability of at least a portion of the sensory apparatus. Citing the total hearing loss which persists in the untreated cases of other authors, as well as two such cases in his own experience, Opheim felt that a reasonable gamble was worth while and explained this gamble as such to the patients. All three persons operated on had relatively uneventful postoperative courses, and hearing for speech was demonstrated within the first two weeks, with ordinary conversation being heard at a distance of up to 2 m. in two of the cases. The audiograms showed hearing for the frequencies up to 500 cps at around 20 to 30 db. levels, with very sharp drops to 100 db. levels at 2000 cps.

Sullivan [50] adds the preservation and, if possible, the improvement of hearing to the time-honored goals of eliminating the danger of intracranial complications and of obtaining a dry ear in complete radical mastoidectomy. Careful surgery with magnification, enabling the surgeon to remove safely all granulations and diseased tissue from the middle ear, including the area of the oval and round windows, prepares the middle ear for a thin skin graft which, when healed, may allow for continued function of the round and oval windows, with maintained or improved hear-

ing. When there is good bone conduction, this hearing can often be further improved in a healed mastoidectomy by the use of an artificial middle ear or plastic korogel insert, as originally described by Pohlman.

Kobrak [51] recommends more frequent consideration of the possibilities of a hearing prosthesis in patients with a considerable hearing loss due to a conduction lesion. He defines a hearing prosthesis as "any device which replaces the function of a part of the sound conducting system of the ear." The author describes the three principal types of prostheses. Any sort of patch prosthesis which closes an eardrum perforation achieves its therapeutic effect by reestablishing a bubble of air in the middle-ear cavity with its important conductive function behind a vibrating membrane. The tympanal prosthesis attached to certain parts of the medial tympanal wall, chiefly in the round window or stapes area, produces its effect of improved hearing by an increase of the mass factor, resulting in a lower resonance frequency and greater amplitude of the lower frequencies. Kobrak also reviews the ossicular prosthesis, which replaces a destroyed ossicular chain and has been described extensively by the Pohlmans.

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Obituaries

HARRIS PEYTON MOSHER, M.D.
1867-1954

Harris Peyton Mosher, A.B., M.D., Sc.D. (Pennsylvania and Colby), died in Boston, Nov. 4, 1954, in the eighty-eighth year of his age.

He was universally acknowledged to be the dean of American otolaryngologists. He was the first president of the American Board of Otolaryngology, and at various times president of the American Laryngological Association, the American Otological Society, the American Larynogological, Rhinological and Otological Society, the American Academy of Ophthalmology and Otolaryngology, the American Broncho-Esophagological Association, and chairman of the Section on Oto-

Professor H. P. Mosher in his laboratory in the Massachusetts Eye and Ear Infirmary.

laryngology of the American Medical Association. He was a member of the Royal Medical Society of London and of the medical societies of Scotland, Paris, and Vienna. He was a recipient of the de Roaldes Medal of the American Laryngological Association for his services to laryngology.

Dr. Mosher was professor of otolaryngology in the Medical School of Harvard University and chief of the department in the Massachusetts Eye and Ear Infimary and in the Massachusetts General Hospital.

He served as an Assistant Surgeon in the United States Army in 1898, and as Colonel in charge of the department of otolaryngology in the United States Army in 1917-1919.

As a teacher he had a distinguished career. In research he added greatly to our knowledge of the anatomy and physiology of the respiratory and digestive tracts. He was an artist of repute, and a writer of invaluable medical works. The medical profession and the specialty of otolaryngology have suffered a great loss in his death.

Abstracts from Current Literature

Ear

THE OTOTOXICITY OF DIHYDROSTREPTOMYCIN AND NEOMYCIN IN THE CAT. J. E. HAWKINS and M. H. LURIE, Ann. Otol. Rhin. & Laryng. **62**:1128 (Dec.) 1953.

The exact mode of action of the antibiotics on the end-organ of the eighth nerve remains unknown, as do the reasons for their differences in specificity. This can be seen in the contrast between the cochlear effects of streptomycin, which effects primarily the internal hair cells and the microphonic potentials, and the effects of dihydrostreptomycin, which appears to act on the external hair cells and the action potentials of the auditory nerve. It is unknown why neomycin should have little effect on the vestibular end-organs and cause profound changes in the cochlea.

The specificity of these substances for the labyrinthine structures, and not for other nerve endings, may be related to a special route of access to the inner ear, according to Hawkins and Lurie. It is believed that these antibiotics may reach the inner ear by being secreted with the endolymph or by way of the cerebrospinal fluid and the perilymph. The latter route seems more likely, as it has been possible to heighten ototoxicity of streptomycin and dihydrostreptomycin by giving minute amounts of these drugs intracisternally in addition to the normal routes of administration. Because of severe ototoxicity, neomycin is unsuitable for prolonged use in the chemotherapy of tuberculosis, according to Hawkins and Lurie.

STEELE, Kansas City, Kan.

A RESEARCH STUDY OF THE EFFECT OF THE AUTONOMIC NERVOUS SYSTEM ON THE INTERNAL EAR. J. H. T. RAMBO, DOROTHY WOLFF, and GRANVILLE FREEMAN, Ann. Otol. Rhin. & Laryng. **62**:1149 (Dec.) 1953.

The authors found no evidence (based on experiments in monkeys) to support the hypothesis that neurovascular disturbances in the middle ear can be brought about by autonomic imbalance.

Their investigations demonstrated that a complete denervation of the sympathetic nerve supply to the inner ear produces no immediate alteration of any significance in the caliber of the labyrinthine vessels; further, after complete denervation of either the sympathetic or parasympathetic nerve supply to the inner ear, observations carried out over a period of 10 days to two months failed to give any sign of damage to the sensory structures of the coclea or labyrinth.

STEELE, Kansas City, Kan.

THE ARTERIES OF THE HUMAN MIDDLE EAR, WITH PARTICULAR REGARD TO THE BLOOD SUPPLY OF THE AUDITORY OSSICLES. GEORGE T. NAGER and M. NAGER, Ann. Otol. Rhin. & Laryng. **62**:923 (Dec.) 1953.

In contrast to previously reported accounts of the sources of blood to the several parts of the middle ear based on studies of injected vascular patterns without benefit of higher magnification, the authors followed the individual blood vessels of the middle ear through serial sections of 110 temporal bones, utilizing a compound microscope with 16-mm., 8-mm., and 4-mm. objectives.

In a large part, the observations are in agreement with those made by previous investigators. Several new facts were revealed, however, with respect to the blood supply of the ossicles. A previously unrecognized branch of the anterior tympanic artery, for which the authors proposed the name "ossicular artery," was found to be the principal blood supply for the malleus and incus. The mucosal network of the ossicles provides only a secondary supply, according to their investigation.

The stapes receives blood from the superficial petrosal, the superior, and the inferior tympanic arteries. None of the arteries in the stapedial region can be definitely identified with the stapedial artery of embryonal life. No vessels of any kind enter the thin parts of the stapes, the central region of the footplate, and the shafts of the crura.

Summarization of the findings is beautifully presented in three illustrations showing the vessels against a background of readily recognizable temporal bone morphology, so as to afford a three-dimensional concept, resulting from tracing the vessels through serial sections.

This article should be of great interest to the student of middle-ear anatomy and is highly recommended.

STEELE, Kansas City, Kan.

OCCUPATIONAL DEAFNESS IN SHIPYARD AND MACHINE SHOP WORKERS. J. C. SCAL, Eye, Ear, Nose & Throat Month. **33**:345 (June) 1954.

Occupational deafness develops in workers who are exposed to loud and continuous noise over a long period of time in the course of their ordinary work. This causes a perceptive deafness, which at first may be only transitory, but following continued exposure to noise, it results in a permanent hearing loss. The deafness is insidious in onset and cannot be recognized early unless it is accompanied by tinnitus, or unless there has been a routine otological examination.

There is a wide variation in susceptibility to acoustic trauma. Another variable is the time factor. There may be no sign of acoustic trauma following exposure to a specific noise of one year's duration, but there may be marked changes following exposure of five years' duration. At first the acoustic trauma involves the high tones only, but later the degenerative process may extend to and involve the lower tones. Complete loss of hearing is seldom found in patients with occupational deafness. The damage to the organ of Corti is at first only transitory and will disappear or improve if the exposure to noise is stopped. Continued exposure to noise will, however, result in a permanent hearing loss. Scal feels that it is necessary to wait for one year after the exposure to noise has ceased before estimating the amount of permanent damage. He considers noise which is less than 100 db. to be reasonably safe except for a few unusually susceptible persons.

Prevention of occupational deafness is more important than therapy. All employees in exceptionally noisy places should have their hearing examined before they are hired, and this should be repeated after the first week, the first month, and after three months. Any employee found susceptible to noise at that time should be changed to a working environment with less noise. Adequate acoustic engineering is important. Other preventative measures include the use of ear plugs and the wearing of rubber-soled shoes. A previous middle-ear deafness shuts out most of the extraneous noises that are found in a noisy occupation and makes it advantageous to employ such persons in occupations which cause deafness.

Repeated audiograms are necessary before estimating the hearing loss of a worker, and, when indicated, simulated deafness must be ruled out by use of one or more of the various tests for malingering.

JENNES, Waterbury, Conn.

Pharynx

IRRIGATION OF NASOPHARYNX AFTER ADENOIDECTOMY. D. A. DE LISA, Laryngoscope **64**:795 (Sept.) 1954.

Irrigation of the nasopharynx with saline at 60 F. following adenoidectomy has apparently prevented postoperative hemorrhage. Previous to this procedure, the incidence of bleeding in De Lisa's cases was 3%. When irrigation was used in 493 cases no hemorrhage occurred. Complete removal and thorough hemostasis at the time of operation are emphasized.

HITSCHLER, Philadelphia.

REMOVAL OF METALLIC FOREIGN BODY IMBEDDED IN THE RETROPHARYNGEAL SPACE: METHOD OF MORE PRECISE LOCALIZATION. LEON M. ARNOLD and MAX L. SOM, Laryngoscope **64**:785 (Sept.) 1954.

The locating and removal of a foreign body embedded in the pharynx or esophagus is very difficult. The Lynch suspension apparatus proved to be of value, particularly because both hands could be used. The locating of the object was aided by the placing of metallic (radiopaque) objects in the field. These greatly narrowed the area to be searched. The object (a wire) was too small for the Berman locator to be of value.

HITSCHLER, Philadelphia.

CANCER OF THE NASOPHARYNX. WALTER L. MATTICK and FRANK C. MARCHETTA, New York J. Med. **54**:2943 (Nov. 1) 1954.

The authors report 82 cases of cancer of the nasopharynx from the Roswell Park Memorial Institute of Buffalo. The period of review ran from 1937 through 1949. Nasopharyngeal cancer constituted 0.3% of all cancer observed, as compared with 0.5% in the tongue and 1.1% in the tonsils. Histopathologically the cases were divided into three grades, which need not concern us here. Diagnosis depends on a careful history plus symptoms and signs of great significance,

such as nasal obstruction of a high degree, nosebleeds, and enlargement of glands in the neck (late diagnosis). Aural symptoms were deafness, fullness, tinnitus, and earache. Eye disturbances were diplopia, ptosis, and exophthalmos. Stress is placed upon a thorough study of the nasopharynx under local anesthesia; the palate is hooked forward, and a No. 2 postnasal mirror is used. This may be supplemented by a direct lighted tube through the nose and Yankauer's tubal speculum for the nasopharynx. Finger palpation is sometimes in order; this is performed by reaching into the vault with an index finger. A biopsy specimen may be taken, under good vision, with biting forceps introduced into the nasopharynx or through the nose, according to the circumstances. The authors state: "We have never seen a carefully performed biopsy do any harm." Surgery is seldom justified, since total removal is impossible. They depend, therefore, upon electrocoagulation and radium or x-ray. Radium can be well placed and held in apposition. Radon gold seeds may be employed after the Hayes Martin procedure. Five-year survival occurred in 21.9%. Prognosis is best in the lymphoepitheliomas without cervical gland enlargement. Periodic reexamination is highly desirable.

I. W. VOORHEES, New York.

Larynx

LARYNGEAL COMPLICATIONS OF ENDOTRACHEAL ANESTHESIA. WALTER H. MALONEY, Laryngoscope **64**:861 (Oct.) 1954.

There are many lesions produced by endotracheal anesthesia. Fortunately, but few are severe or permanent. Even the motion of the cords produced by breathing may cause trauma when a foreign body (tube) is present. The tube may be placed into the easily perforated pyriform sinuses. The technique and skill of the operator are most important factors in the production or avoidance of trauma.

Complications such as abrasions, edema, laceration, and hemorrhage may occur within 48 hours of the intubation; ulceration and granuloma develop from days to six months later. Pain, hoarseness, and an obstructive phenomenon will be present. Examination should be made and treatment instituted. The latter consists of (1) avoidance of trauma at intubation, with particular caution regarding children; (2) local measures, such as humidity, inhalations, chemotherapy, vocal rest, and avoidance of smoking; (3) direct endoscopic removal of granuloma or fibrinous exudate, etc. Tracheotomy may be necessary.

In all this work there must be close coordination between the laryngologist and anesthesiologist.

HITSCHLER, Philadelphia.

Nose

ABSORPTION FROM THE NASAL MUCOUS MEMBRANE. REED W. HYDE, JUERGEN TONNDORF, and HERMAN I. CHINN, Ann. Otol. Rhin. & Laryng. **62**:957 (Dec.) 1953.

Using the depression of salivary secretion as the most reliable criterion of absorption of scopolamine (Hyoscine) and atropine, the authors investigated the systemic effects of these drugs when applied intranasally in young Air Force personnel. In addition, studies were carried out on the rates of absorption of the same drugs from different areas of the upper respiratory tract.

At 15 and 30 minutes following administration, there was less absorption of scopolamine from the mucosa of the nasal septum and the nasopharynx than from other parts of the nasal cavity. As more time passed, the difference was no longer of statistical significance. There was little difference in the systemic effects of scopolamine nose drops, regardless of whether they were applied to the roof of the nasal cavity, floor of the nose, or to the inferior turbinate.

Subcutaneous injection resulted in the most rapid and complete absorption. Nose drops and nasal spray (in detergent) were intermediate in effect between subcutaneous and sublingual routes, being closer to the subcutaneous route in efficacy. It was found that sublingual tablets were absorbed slightly more rapidly than oral capsules.

Adding a detergent or hyaluronidase to atropine nose drops had no effect on the rate or degree of absorption. Atropine produced more side-effects and showed lower antisialogogic activity but was not more slowly absorbed intranasally or subcutaneously than scopolamine.

STEELE, Kansas City, Kan.

Miscellaneous

AEROSOL ADMINISTRATION OF ALEVAIRE: I. TECHNICS. VINCENT D. KRACUM and VINCENT J. COLLINS, New York J. Med. **54**:2083 (July 15) 1954.

"Alevaire" is a detergent solution used in respiratory conditions in which there is a high viscosity, such as in atelectasis (neonatal), spasmodic croup, bronchiolitis, asthma, bronchiectasis, and tuberculosis. Kracum and Collins have been working with this solution at St. Vincent's Hospital, New York. It is prepared by the Winthrop Stearns, Inc. The formula is not given in this article, but "alevaire" can be combined with oxygen in varying proportions, so that infants as well as adults can derive benefit from it. Six illustrations show the kinds of apparatus used. Economy and simplicity of administration are emphasized, for conventional inhalation therapy equipment can be applied. Since this is Part I of the series, it is assumed that the authors will make further studies available which will show the chemical change which reduces the viscosity of secretions so that they can be readily removed by coughing, aspiration, postural drainage, etc.

I. W. VOORHEES, New York.

INFANTILE CORTICAL HYPEROSTOSIS. H. G. RISCHBIETH, Clin. Rep. Adelaide Child. Hosp. **2**:130 (May-Nov.) 1953.

A case of infantile cortical hyperostosis is described and the differential diagnosis outlined. A review of the literature is included.

McGUIGAN, Evanston, Ill. [A. M. A. AM. J. DIS. CHILD.].

CASE OF OTITIC HYDROCEPHALUS OF INTRACRANIAL HYPERTENSION. R. H. VON DER BORCH, Clin. Rep. Adelaide Child. Hosp. **2**:156 (May-Nov.) 1953.

Severe intracranial hypertension occurred in a child who had had an earache three weeks previously that had apparently responded well to sulfonamide. The eardrum appeared normal. Because of severe symptoms and probable venous sinus thrombosis, mastoidectomy was done, revealing extensive perisinuous clotting and apparent mural thrombosis inside the sinus. Recovery was slow but after four months was almost complete.

McGUIGAN, Evanston, Ill. [A. M. A. AM. J. DIS. CHILD.].

RELATION OF Q-T TIME TO SERUM CALCIUM IN THE SYNDROMES OF TETANY. R. RIZZI and C. ARENA, Lattante **24**:433 (July) 1953.

Electrocardiographic and blood calcium studies were made in eight cases of rachitic tetany, in two cases of parathyroid tetany, and in one case of essential tetany. The Q-T time, i. e., the duration of the electrical reaction of systolic contraction, was found to be markedly prolonged in the two patients with parathyroid tetany, somewhat prolonged in the patient with essential tetany, slightly increased in two of the patients with rachitic tetany, and unchanged in the other six patients. When calcium chloride had been given intravenously, the Q-T time was shortened, but this change was not in proportion to changes in the biologically active calcium content of the blood serum.

HIGGINS, Boston [A. M. A. AM. J. DIS. CHILD.].

ISCHAEMIC FACIAL PALSY: RESULTS OF DECOMPRESSION OF THE FACIAL NERVE IN 108 CASES; PRELIMINARY REPORT. KARSTEN KETTEL, Acta oto-laryng., Supp. 116, p. 155, 1954.

The term Bell's palsy has been used indiscriminately for almost every kind of peripheral facial palsy, regardless of its nature. In the present paper the term is restricted to cases in which the facial palsy is the only clinical symptom, and in which it has been impossible to demonstrate a local causation.

The primary cause of the majority of Bell's palsies is an ischemia of the facial nerve near the stylomastoid foramen, probably caused by arteriolospasm. As a result of this, various structural alterations take place in the facial nerve between the lateral semicircular canal and the stylomastoid foramen, and in some cases also in the surrounding bone.

The ischemia is the primary cause of paralysis, and because of this, the nerve loses its conductive power. The ischemia of the nerve is followed by edema and this, in turn, by secondary compression of the nerve and especially its vessels within the facial canal, so that a vicious circle arises.

With practically no knowledge about the etiology of Bell's palsy, it is impossible to prevent it from arising, and we can only try to combat the primary cause, the ischemia, and prevent or at least reduce the secondary compression within the facial canal.

Medical treatment is the therapy of choice, as it aims at correcting the primary disturbance of the vasa nervorum, and has resulted in the complete recovery of 75 to 85% of cases. Decompression is, however, definitely indicated in a limited number of cases, but to find a sound basis for surgical intervention is the great problem of today.

In selecting cases for operation, many authors rely completely upon the response to the faradic current, claiming that a complete recovery will never take place when the response is negative. Others, however, do not consider this to be a reliable indicator, having seen many patients with a negative response recover completely. In exactly the same way opinions differ regarding the value of electromyography.

I have on empiric indications operated on 108 cases of ischemic palsy. My indications were the following:

a. Delay in Recovery.—Of 44 patients, the treatment was finished in 39, and all were reexamined. Those patients (the majority) were operated on in whom no signs of recovery were present after two months of observation. Six recovered completely, and 33 could smile and laugh to varying degrees, and all could screw up the eye. Comparison between the results obtained in palsy patients showing delayed recovery by medical and surgical treatment shows that surgery definitely gives better results, but also that complete recovery is the exception, certainly not the rule. Contractures are almost avoided, and the synkinesis seems to be less pronounced than in cases treated medically.

b. Cessation of the Spontaneous Recovery of Mobility Before Complete Restitution is Obtained.—To this group 41 patients belonged, and 39 were reexamined. Considerable improvement followed in 19 cases. Two of these, in whom decompression was performed one and three months after the cessation of spontaneous improvement, recovered completely. In 11 cases a moderate improvement resulted, which was, however, valued by all the patients. In three cases the improvement was only slight. In two cases the result was doubtful. In three cases there was no improvement, but one of these was relieved of a troublesome headache and a feeling of stiffness in the cheek. In one case the patient was worse than before operation.

c. Relapsing Palsies.—Twenty-three patients, all with complete palsies, were operated on shortly after the recurrence, and the results were as follows: Four patients recovered fully after decompression. Fourteen patients recovered with only minor defects. Having spontaneously recovered only partially after their first attacks, five patients regained movement to the same extent after decompression. In one case a relapse occurred 11 years later, with ensuing recovery to the same extent as before the relapse.

I have seen two cases who suffered from a recurrence on the side previously decompressed. In both, however, the palsy disappeared again spontaneously and completely in a short time.

This is clinically a very distressing phenomenon, but most interesting from a pathological point of view. It confirms that the primary cause of the palsy is ischemia of the nerve, not the secondary compression within the Fallopian canal, as this had been opened previously.

Till better tests are available, which from the onset can distinguish between the 75 to 85% of cases which recover spontaneously, decompression should be performed in both fresh and relapsing palsies if no signs of spontaneous movement are observed after two months of observation. With patients in whom spontaneous recovery has ceased before complete restitution has been obtained, further improvement may be expected from decompression.

AUTHOR'S ABSTRACT, Hillerød, Denmark.

THE EFFECT OF STELLATE GANGLION BLOCK ON BELL'S PALSY. TATSUO NAKATA, Otolaryngology (Tokyo) **26**:15 (Jan.) 1954.

There are three known approaches to the stellate ganglion. Nakata prefers the anterior route, by which he introduces daily 10 cc. of 1% procaine hydrochloride (Novocain) solution for a period of 10 days. In favorable cases he noticed improvement in the facial expression in five or six days after initiation of the therapy. This form of treatment was attempted on eight cases, and there was only one failure. He states that chances of recovery from Bell's palsy are greatest if the blocking is performed within a week after onset of the illness.

HARA, Los Angeles.

Directory of Otolaryngological Societies *

FOREIGN AND INTERNATIONAL

Canadian Otolaryngological Society
(Société Canadienne d'Otolaryngologie)

President: Dr. G. Edward Tremble, 1390 Sherbrooke St. West, Montreal, P. Q.
Secretary: Dr. G. Arnold Henry, 170 St. George St., Toronto.
Place: Bigwin Inn, Lake of Bays, Muskoka, Ont. Time: June 16-18, 1955.

International Bronchoesophagological Society

President: Dr. André Soulas, 184 Avenue Victor Hugo, Paris 16.
Secretary: Dr. Chevalier L. Jackson, 3401 N. Broad St., Philadelphia 40.

International Congress of Audiology

Place: Leyden, Netherlands.
General Secretary: Dr. H. C. Huizing, 182 Oostersingel, Groningen, Holland.

International Course in Paedo-Audiology

Place: Groningen, Netherlands.
General Secretary: Dr. H. C. Huizing, 182 Oostersingel, Groningen, Holland.

Pan-American Association of Oto-Rhino-Laryngology and Broncho-Esophagology

President: Dr. Juan Manuel Tato, Azcuenaga 235, Buenos Aires, Argentina.
Secretary: Dr. Chevalier L. Jackson, 3401 N. Broad St., Philadelphia 40.
Meeting: Fifth Pan-American Congress of Oto-Rhino-Laryngology and Broncho-Esophagology.
Place: San Juan, Puerto Rico. Time: February, 1956.
President of Congress: Dr. Juan H. Font, Medical Arts Building, San Juan.

Sixth International Congress of Otolaryngology

President: Dr. Arthur W. Proetz, 3720 Washington Blvd., St. Louis.
General Secretary: Dr. Paul H. Holinger, 700 N. Michigan Ave., Chicago 11.
Place: Hotel Statler, Washington, D. C. Time: May 5-10, 1957.

NATIONAL

American Medical Association, Scientific Assembly, Section on Laryngology, Otology and Rhinology

Chairman: Dr. Francis W. Davison, Geisinger, Memorial Hospital, Danville, Pa.
Secretary: Dr. Hugh A. R. Kuhn, 112 Rimbach St., Hammond, Ind.
Place: Atlantic City, N. J. Time: June 6-10, 1955.

American Academy of Ophthalmology and Otolaryngology

President: Dr. Walter H. Theobald, 307 N. Michigan Blvd., Chicago 1.
Executive Secretary-Treasurer: Dr. William L. Benedict, 100-1st Ave. Bldg., Rochester, Minn.
Place: Palmer House, Chicago. Time: Oct. 9-15, 1955.

* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.

American Board of Otolaryngology

President: Dr. Frederick T. Hill, Professional Building, Waterville, Maine.
Secretary-Treasurer: Dr. Dean M. Lierle, University Hospitals, Iowa City.
Examinations: Hotel Marshall, Richmond, Va., March 6-10, 1955; Palmer House, Chicago, October, 1955.

American Broncho-Esophagological Association

President: Dr. Clyde A. Heatly, 11 N. Goodman St., Rochester, N. Y.
Secretary: Dr. F. Johnson Putney, 1719 Rittenhouse Sq., Philadelphia 3.
Place: Hollywood Beach Hotel, Hollywood, Fla. Time: March 15-16, 1955 (afternoons only).

American Laryngological Association

President: Dr. Henry B. Orton, 224 Delavan Ave., Newark 4, N. J.
Secretary: Dr. Harry P. Schenck, 326 S. 19th St., Philadelphia 3.
Place: Hollywood Beach Hotel, Hollywood, Fla. Time: March 13-14, 1955.

American Laryngological, Rhinological and Otological Society, Inc.

President: Dr. Kenneth M. Day, 121 University Place, Pittsburgh.
Secretary: Dr. C. Stewart Nash, 708 Medical Arts Bldg., Rochester 7, N. Y.
Place: Hollywood Beach Hotel, Hollywood, Fla. Time: March 15-16, 1955 (mornings only).

SECTIONS:

Eastern.—Chairman: Dr. Benjamin H. Shuster, 1824 Pine St., Philadelphia 3.

Southern.—Chairman: Dr. G. Slaughter Fitz-Hugh, 104 E. Market St., Charlottesville, Va.

Middle.—Chairman: Dr. James E. Croushore, 3001 W. Grand Blvd., Detroit.

Western.—Chairman: Dr. Victor Goodhill, 2007 Wilshire Blvd., Los Angeles.

American Otological Society, Inc.

President: Dr. D. E. Staunton Wishart, 170 St. George St., Toronto 5, Canada.
Secretary-Treasurer: Dr. John R. Lindsay, 950 E. 59th St., Chicago 37.
Place: Hollywood Beach Hotel, Hollywood, Fla. Time: March 17 (afternoon), 18 (forenoon and afternoon), and 19 (forenoon), 1955.

American Otorhinologic Society for the Advancement of Plastic and Reconstructive Surgery, Inc.

President: Dr. Matthew S. Ersner, 1915 Spruce St., Philadelphia 3.
Secretary: Dr. Louis Joel Feit, 66 Park Ave., New York 16.

American Society of Ophthalmologic and Otolaryngologic Allergy

President: Dr. F. Lambert McGannon, 14595 Madison Ave., Lakewood, Ohio.
Secretary-Treasurer: Dr. Michael H. Barone, 468 Delaware Ave., Buffalo 2.
Place: Palmer House, Chicago. Time: 1955.

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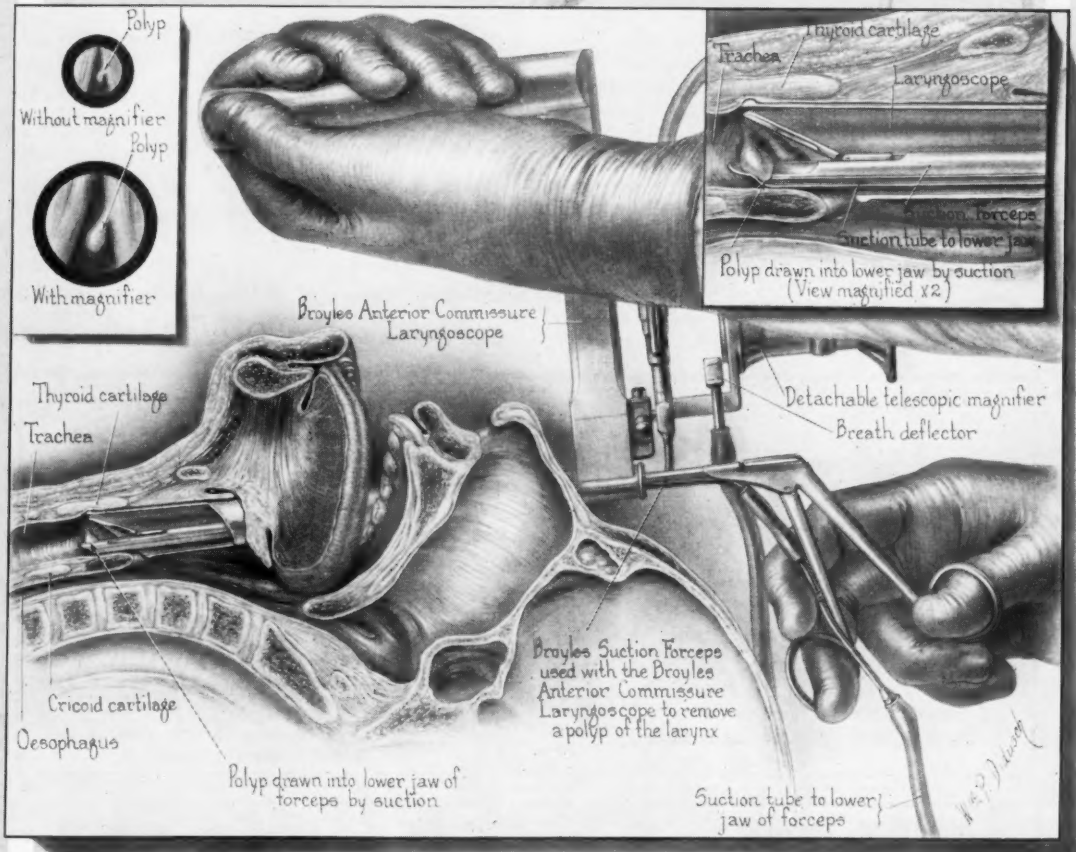

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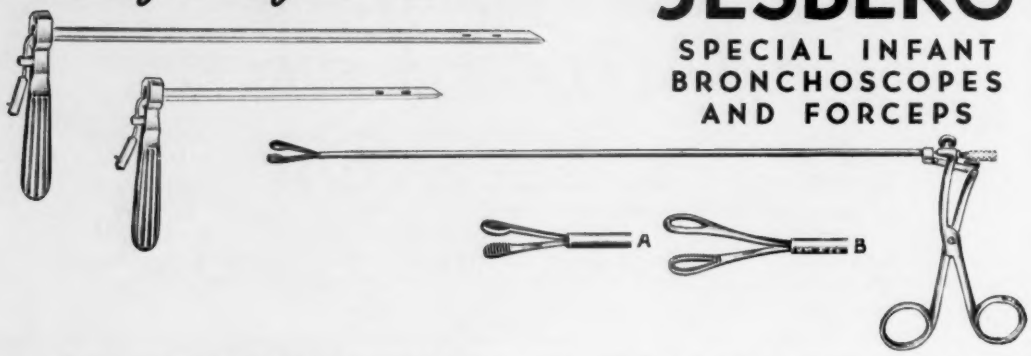

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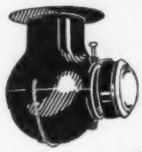

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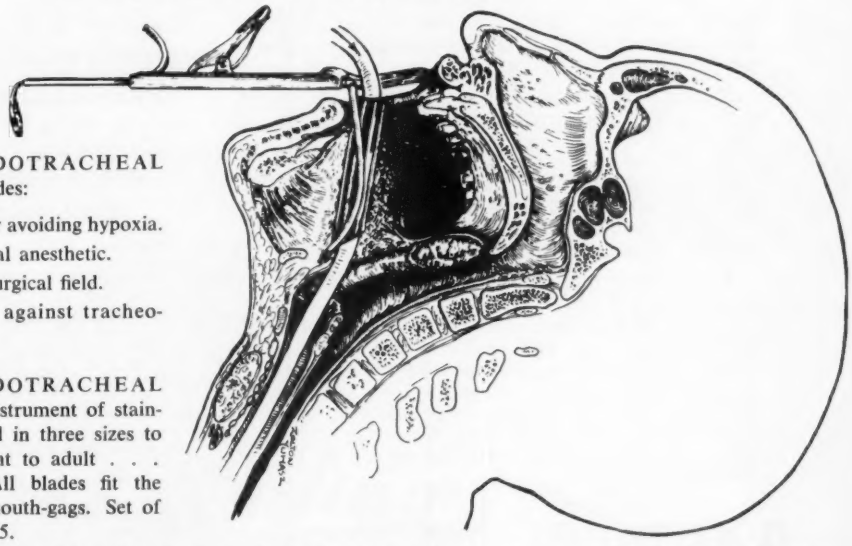

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*Barton, R. T.: Instrument for endotracheal anesthesia during oro-pharyngeal surgery. J. A. M. A. 153:1017 (Nov. 14) 1953.

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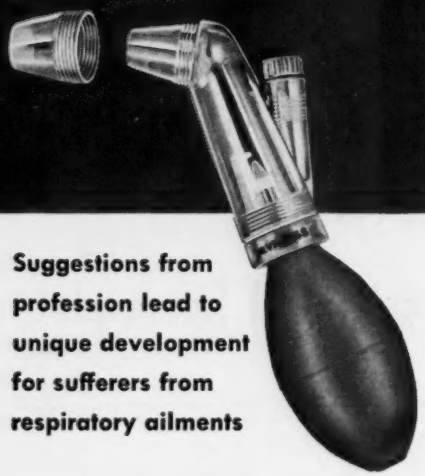

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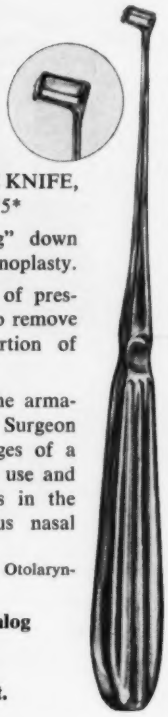

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